135

THE PSYCHOLOGICAL FOUNDATIONS OF EDUCATION SERIES

The Psychology of Learning in the Classroom

ROBERT C. CRAIG

167

~~1298~~

3982
29.4.87

THE PSYCHOLOGY *of* LEARNING *in the* CLASSROOM

STATE INSTITUTE OF EDUCATION
BANIPUR

~~1278~~

~~2/5/[illegible]~~

THE PSYCHOLOGY
of LEARNING
in the CLASSROOM

Robert C. Craig

PROFESSOR OF EDUCATION
MARQUETTE UNIVERSITY

THE MACMILLAN COMPANY, NEW YORK
COLLIER-MACMILLAN LIMITED, LONDON

S.C.E.R.T., West Bengal
Library
Calcutta
25/3, B[illegible] Road

S.C.E R T., West Bengal
Date 29.4.87
Acc. No. 3982

© Copyright, Robert Craig, 1966

All rights reserved. No part of this book may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, recording or by any information storage and retrieval system, without permission in writing from the Publisher.

First Printing

Library of Congress catalog card number: 66–10763

THE MACMILLAN COMPANY, NEW YORK
COLLIER-MACMILLAN CANADA, LTD., TORONTO, ONTARIO

Printed in the United States of America

370.105
CRA

Preface

THERE ARE MANY excellent reasons for teachers to learn more of different explanations of learning, even though there is no completely adequate theory of how and why students learn. Consider at least the following:

1. The teacher must make decisions about aspects and problems of learning when there is no substantial agreement among either the theorists or the practitioners of education and no relevant research findings. For many such decisions particular learning theories will offer suggestions worthy of a trial in the classroom.

2. In almost every practical situation, the application of even widely accepted generalizations about learning is influenced by some broader concept the teacher has of priorities in learning—that is, of what is of greater and of lesser importance. A point of view derived from a knowledge of theories of learning, although still inadequate, will almost certainly prove a better general guide than notions based on folklore, intuition, or trial and error.

3. Continuing contributions to the understanding and control of practical learning may be expected from psychologists with different theories. An expanding stream of evidence as to desirable limitations and qualifications of different views will surely be forthcoming. Some acquaintance with major theories will be needed if the teacher is to be literate in reading about new experiments and new proposals.

4. Finally, a professional educator needs to know something of different theories to evaluate the frequently heard charges that this or that practice is absurd because it is based on an outmoded psychology, or the equally insistent claims that proposed urgent changes are in line with the "new psychology." The fact

is that most educational practices or proposals cannot be so sharply separated in terms of psychological theory, but in each instance the teacher will want to satisfy himself that this is the case.

These are reasons also for a book that reviews the major varieties of learning theory in relation to educational practice. Not all teachers who learn something of theoretical approaches to learning here will find the same approach most useful, of course. Some, perhaps most, readers will choose elements from several theories. Their preferences will lead to differences in classroom practices, however, and another purpose of this book is to identify the probable differences. Not that they are undesirable! Similar differences among psychologists and other scientists have been more of a spur to progress than a drag upon it.

In this brief volume our purpose is to present the elements of each of the current theories of learning for the classroom teacher. An attempt has been made to do this with a minimum of technical terminology and to show by many illustrations and examples how an understanding of learning theory contributes to the purposes stated above.

Chapter 1 presents a general description of the elements of learning that has rather wide acceptance in educational psychology. This is a convenient and logical starting point for supplementary material relating to theoretical differences and their classroom implications in later chapters. The next three chapters survey the major viewpoints and their emphases with respect to the elements of learning described in Chapter 1. If asked about learning, the contiguity theorist (Chapter 2) might answer, "We learn *what we do*." The reinforcement theorist (Chapter 3) would qualify this, however, preferring, "We learn to do *what is satisfying*." The cognitive theorist (Chapter 4) would discount the need to *do* anything and would say, "We learn when we achieve *understanding*."

Finally, in Chapter 5 the suggestions of these theories are applied to the use of teaching machines, teacher presentations, and student activities. When earlier concepts are reexamined in these instructional contexts, theoretical differences will emerge with greater clarity and with greater significance for teachers.

R. C. C.

Contents

CHAPTER PAGE

1 An Overview of the Learning Process 1

2 Contiguity Theories and Education 21

3 Reinforcement Approaches to Learning .. 35

4 Concepts from Cognitive Theories 50

5 Relating Theory and Practice 64

References 83

THE PSYCHOLOGY
of LEARNING
in the CLASSROOM

1

An Overview of the Learning Process

ANY TWO examples of learning differ; yet they and others have some common features.[1] Think of an actual person of your acquaintance with his unique combination of abilities and experience. These determine his *readiness* for learning in any situation. He is *motivated* in a given situation by his drives and desires to seek *goals*. He *explores* the situation and *acts* in ways that may attain his goals. Finally, he reacts to the *consequences* of his acts. Appropriate acts—that is, those that lead to his goals—are more likely to be repeated in similar situations. Inappropriate ones are not. Either way, he has changed, and he has learned. Of course, he may react to some consequences with emotional and erratic behavior that does not help him attain his goals.

Our division of learning into an orderly sequence of parts is an academic or pedagogical device, of course. The progress of actual learners is seldom so uniform or systematic. Some appear to skip the selection of a goal or the exploration of the situation, while others linger over these phases of the process or return to them again and again. The order and the prominence of any elements of the type we suggest must vary; yet assuming that they are there will further our study.

In order to postpone theoretical controversies temporarily, our brief outline of learning neither emphasizes nor rules out the possibility that the learner uses unobservable or internal, intelligent, and willful processes in selecting and seeking his goal or in reacting to the consequences of his actions. It is noncommittal also with respect to why appropriate responses are fixed and inappropriate ones are dropped. We will return to these issues, however.

---

[1] Common elements in descriptions of learning have been summarized for the educator by a number of authors. More recent texts have been influenced by Dashiell (1935), McConnell (1942), and Hilgard (1956).

AN EXAMPLE OF INFORMAL LEARNING

The general pattern of learning that has been suggested is often strikingly evident in informal situations. One example, which was observed only recently, centers around a boy seven or eight years of age in his father's workshop. Two older brothers are working on Boy Scout projects. The situation includes scrap lumber and simple tools they may use. Even the youngest boy has used a hammer and saw previously and now is ready to undertake simple woodworking projects. He appears to be motivated by a desire to share his brothers' interests, to belong, as well as by curiosity and a need for activity. He picks up a piece of plywood about two feet square and looks it over. After a moment he mentions that he doesn't have a desk of his own and that he would like to make one. This becomes his goal.

He explores the situation by sorting a pile of wood scraps and selecting several pieces which he arranges in tentative formations resembling various desks and tables in his home. Finally, he picks out a four-inch-square post about two feet long and nails the large piece of plywood to one end for the top and a smaller one foot square of the same material to the other end for the base.

The consequences of this action are not entirely satisfactory, for the top-heavy "desk" won't stand alone. Then his oldest brother calls the boy's attention to the design of a tall hat rack in one corner of the shop. The boy reacts by beginning anew with other pieces of wood, and his desk soon has a wider base and greater stability.

The consequences of this new try may extend beyond the achievement of his immediate goal. They may include, for example, greater self-confidence, increased desire and readiness for other activities, and fuller acceptance by his brothers. Perhaps this young learner will be less likely to repeat his initial mistake in making tables, hat racks, or similar products. He may be slightly more sensitive, in at least an intuitive way, to other problems created by a high center of gravity over a small base. He may be more cautious about standing in a canoe, for example.

LEARNING IN SCHOOL CONTEXTS

The description of what happens when we learn gains further reality when it is considered in school contexts. Only one such illustration will be given here, but others are suggested later, especially in Chapter 5. The present example is based on a group discussion described by Lindgren.[2] The history teacher whom we meet was interested primarily in motivating the study of a new topic, but some rather immediate learning outcomes are also evident.

The situation is this. A high school class is beginning the study of Civil War leaders. They are building on readiness developed in their previous study of this period of American history. The students' past experience leads them to expect that they will be asked to write on assigned essay topics, but Mrs. Murdock has been following the debate on continuing atomic testing and has recognized the possibility of using this issue to motivate the study of Lincoln. She baffles her class momentarily when she says:[3]

> Because of our admiration for Abraham Lincoln as a president and as a person, we know him perhaps better than almost anyone else in history. He had to make decisions about issues as crucial and perplexing to the people of his time as the questions regarding the atom bomb are to us today. Now, what do you think he would decide regarding continued experimentation with the atom bomb if he were alive and president today?

Lindgren reports that a heated debate soon develops during which the teacher does little more than keep the enthusiasm within proper bounds. When the students begin to repeat themselves, she stops them and summarizes the several ideas presented. She then helps them to recognize that nothing can really be decided, for they lack facts. They don't know how he decided the many crucial decisions that faced him. Interest in the question is still high, so the class decides to form teams and make definite plans to get the information they need for further discussion.

---

[2] H. C. Lindgren, "The Teacher Helps the Learner Interpret His Experiences," in *Learning and the Teacher*, 1959 Yearbook (Washington, D.C.: Association for Supervision and Curriculum Development, 1959), pp. 95–97. Subsequent selection is reprinted by permission.

[3] *Ibid.*, p. 95.

Mrs. Murdock knew her class and decided that she would use a discussion to motivate students by arousing their competitive spirit and their curiosity concerning an important current event. The continuing goals of greater knowledge—of Lincoln, of problems in a crucial period of our history, and of factors and values influencing the decisions of a great man—will undoubtedly contribute to the history teacher's objectives.

More immediately, within the limits of this period, we may imagine students roused to activity with the goal of marshaling ideas and arguments that would rout the opposition and win the approval of the teacher. When their attempts to attain this goal by hastily formed opinion and lung power fail, at least some turn to exploring a new strategy with the teacher. They recognize the complexity of the problem and the need for collecting and organizing pertinent facts.

The teacher now has an opportunity to make allowances for differences in the readiness of different members of the class—in the formation of teams, in the division of further responsibility, in recommending sources of varying levels of difficulty, and so on. These steps help to insure that the consequences of the next step will mean success for as many students as possible. Varied experiences of a similar nature with other problems and issues will help encourage the continued use of more effective procedures for reaching decisions.

Before leaving this example review it again and identify the major elements of learning—readiness, motivation and goals, exploration and action, and reaction to the consequences—as they might be experienced by a student during the class discussion and again in the follow-up activities planned.

The elements of the learning process will be described more fully in the remaining sections of this chapter. A number of noncontroversial generalizations, such as are found in educational psychology texts, are summarized for each element. These general statements serve to review the common ground from which we later move, first in one theoretical direction and then in another. They also provide a useful, if brief, summary of the learning concepts and conclusions that are developed and elaborated in standard courses and texts.

READINESS FOR LEARNING

The teacher should ask two questions routinely: (1) What does a student need to know or be able to do before he can learn this new thing in the way I plan to teach it? (2) To what extent do my students possess this prerequisite knowledge and ability? The teacher may or may not know his material and students well enough to answer these questions, but this approach illustrates an understanding of readiness as a condition for learning. The readiness of each learner is the degree to which he has the prerequisites for new learning. Although this concept is simple and direct, further generalizations concerning the readiness of students for the study of a particular subject or topic are more difficult.

For one thing, readiness is never for a subject or topic itself but for specific requirements which vary with the way we teach. In learning to read, for example, a child is usually expected to (1) be familiar with common objects and simple concepts of space and time; (2) follow oral directions; (3) discriminate among complex sounds; (4) recognize slight differences in word form; (5) follow a prescribed visual pattern of left to right and down the page; (6) use crayons, scissors, paper, and other materials; and (7) focus or sustain his effort and attention for at least a brief period of time. Although some combination of these and still other requirements will make the difference between students' readiness for reading and the lack of it, the relative importance of any factor may change with the materials and methods of instruction. Firsthand experience with the objects or events represented by new words may be either assumed or systematically provided; and in teaching new words some approaches emphasize the recognition of differences in the general form or pattern of words, while others concentrate on the sounds of different letter combinations.

Some of the abilities required for success in beginning reading are clearly learned; others may be largely a result of maturation—that is, changes with age which are relatively independent of experience. In this, reading is probably fairly representative of other school tasks. Both maturation and prior learning are factors in readiness; but the relative importance of each undoubtedly varies for different methods of teaching because of the specific activities of students under each. This fact has not always been well understood. In the 1930's, research on the learning of skills and functions such as toilet training, walking, cube stacking, and chair climbing suggested that maturation was generally the most important factor in learning. Any initial superiority of children given early systematic instruction in such tasks was quickly overcome later by other children of the same ages when they were ready for these activities. Consequently, whenever children experienced difficulty in school, postponing instruction until they were more mature was recommended.

Other evidence was soon forthcoming, however, to show that early instruction in skating, playing a musical instrument, or forming the sounds of a foreign language can lead to permanent gains. Some psychologists and educators then concluded that maturation is the more important factor in skills and functions that everyone usually acquires sooner or later, but that systematic practice or instruction plays the larger role in more individual, less universal, attainments. This is about where matters stand at present. Thus, although there are some maturational minimums below which instruction would be too inefficient, prior learning is probably the more important factor in readiness for most school tasks.

If prior learning, maturation, and methods of instruction all make a difference, age or grade levels can provide only very general guides to students' readiness for learning a given element of subject matter or skill. Success in beginning reading often requires a score on a test of general intelligence equal to that of a child of six years and six months, but not always. The seventh grade is the optimum grade for teaching long division in some schools but not in others. These are examples of placements of subject matter that are being challenged widely at the present time. As a matter of fact, special methods and materials, such as typewriters, have been used to teach children of three to read, spell, and, of course, type. Also, topics in science and mathematics formerly reserved for advanced students are being introduced experimentally in every grade from one to six. The dramatic success of some such efforts is probably due, as the preceding paragraphs should suggest, to either (1) adaptation of methods and materials to the readiness of younger students or (2) the selection of students who are exceptionally mature and/or experienced for their age.

The importance of the readiness of the individual as an ideal in all instruction can scarcely be overstressed. The student who lacks readiness for new learning cannot hope to progress satisfactorily until his deficiencies are identified and overcome or until a way is found to reach him on his level. When a student is fully ready for a task, on the other hand, his progress should be smooth and easy. If all teachers would make a deliberate effort to use the concept of readiness in the organization of their instruction there would be fewer difficult courses. The many disinterested and failing pupils in high school and college offer ample evidence that the problem of readiness is as acute at these levels as in the elementary school, where it has received the most attention.

MOTIVATION AND GOALS

Motives are internal states that direct our activity toward related goal objects or conditions. Some of these forces are the result of bodily requirements. Hunger and thirst lead us to seek food and drink. The motives that teachers use—such as those for achievement or advancement, approval or social acceptance, and activity or curiosity—may be learned in the process of meeting physiological needs. The trend in psychology today, however, is toward accepting a wide range of motives as part of our original nature.

Whatever their origin, our motives determine the goals we seek. At any one time we have not merely one goal but many. Examples for a high school student might be as varied as a seat in the rear of the room, a "C" grade on today's quiz, an understanding of relativity, a date for Saturday's dance, and a place on the varsity team. The same student's goals for the more distant future may include graduation, marriage, a place in the country, and a career in business.

Although motives reside within the learner, they can be influenced from without. Hence, motivation sometimes refers to the efforts of others to arouse learners' motives and guide their choice of goals. The principal motivational activities of teachers are (1) controlling opportunities for the operation of motives and the choice of goals and (2) offering incentives for learning.

The control of opportunity has both its positive and negative aspects. Positively, the teacher arranges for students to find goals related to their existing motives in school activities. One teacher, for example, reported accelerated interest and achievement in the study of measurement when eighth-grade students were encouraged to chart and interpret their own physical changes. A concern for bodily changes is one of the characteristics of this age group that are related to motives of social acceptance and self-esteem.

A related positive approach is to tie school tasks to the attainment of a student's already recognized short- or long-term personal goals, thus making the completion of the tasks important subgoals for him. Understanding of the fulcrum can be presented as a way for young children to have more fun with teeter-totters; shop skills can make it possible for older boys to earn more spending money; and better communication skills are always a step toward vocational success.

More negatively, perhaps, the teacher also must restrict students' opportunities to work toward goals that are irrelevant to the immediate objectives of instruction. This is a matter of selection, of the concentration of attention and effort. In a flower garden a cabbage plant is just another weed, and so it is that even worthy goals and motives must be suppressed at times. In other words, the selection and presentation of materials is intended to limit as well as to suggest the learner's choice of goals. In a study of instruction in botany, for example, it has been found advisable to study the identification of the parts of a flower with the aid of a drawing before looking at the actual flower. Without such preparation real flowers arouse in the pupil other interests that compete with those more closely related to the objectives of instruction. For similar reasons a businesslike classroom with a minimum of random noise and activity may be recommended.

Teachers make extensive use of incentives designed to intensify learning activity. Positive incentives include the promise of prizes, privileges, praise, or high marks. Examples of negative incentives are threats, demands that imply threats, and the promise of low marks. Both types are used, but there is consensus on the fact that learning proceeds better under the influence of positive rather than negative incentives.

There is widespread concern, however, that positive incentives may become too important to the student and distract him from the intrinsic values of school subjects and learning activities. He may work for the "A" rather than the understanding it should represent. The point is that students need to acquire worthy ways of satisfying their motives as well as knowledge and skill.

A relatively optimistic view is that students will surely find intrinsic rewards in school learning if you can once get them started and keep them working at it. Thus, there is merit in "baiting the trap" with any available incentive. This may or may not be effective in general practice. It appears more likely to work if two conditions exist: First, the "bait" should be within reach of most students. This probably means that praise and marks are given for approval or progress rather than rank in class. Second, once students are into learning situations they must experience satisfaction and success. We cannot assume that students of diverse abilities and interests will. We have to provide for it, and then we are back to controlling opportunity.

An important further consideration in the use of incentives is that motivation that is too intense is disturbing and distracting and often less effective than moderate motivation. This is especially true of fear or anxiety aroused by threats or competition. Some children and adults are especially prone to be apprehensive in any test or other evaluative situation, while others are actually too relaxed to do their best. There is only a little direct evidence on the effect of different motivational procedures upon the achievement of "high anxious" and "low anxious" students, but we may suppose that the former group would respond better to reassurance and a calm confident demeanor, while the latter might be stimulated, at least temporarily, by exhortation or other forms of pressure.

LEARNER EXPLORATION AND ACTIVITY

The learner's exploration of a situation may be covert or overt, conscious or unconscious, brief or prolonged, superficial or thorough, random or purposeful. His personal characteristics and a number of variables in the situation affect what he does at this stage of learning.

When the teacher gives information or supplies correct answers, exploration may be at a minimum. If we assume a student's immediate goal is to know what the teacher tells him, because he is interested or for other reasons, only one general course is open to him. The situation is probably not quite that simple, however. We all know that there are many different ways of listening and taking notes during a lecture, for example. Whether the student realizes it or not, he probably changes his approach at least slightly a number of times during every lecture. When what he is doing doesn't seem adequate in relation to his goal, he may listen more intently or take more detailed notes. On the other hand, he may decide that neither notes nor listening is necessary.

If exploration is least obvious in reception learning, it is most obvious in active learning or problem solving. Still, if a problem is a simple one and similar to others with which the learner has had experience, he may act quickly and without apparent hesitation. Of course, when a habitual response is adequate, he learns little or nothing. If a task is more complex, he may deliberately analyze the situation, relate his impressions to his past experience, and predict the probable results of various actions open to him. At least he may appear to do this. If the situation is very complex and foreign to his experience, he may just try a number of things, apparently at random.

The learner's action or response with respect to his goal may be tentative, if he is unsure. It may be unnoticed by an observer and consist of self-instructions, thoughts, or an emotional change. It is quite possible that the learner may not be entirely aware of his response.

Teachers guide learner exploration and activity in both direct and indirect ways. Indirectly, guidance is given when materials are selected, organized, and presented in ways that make appropriate responses more probable. Somewhat indirectly also, teachers may be models for the learning behavior of students who have learned that one way to achieve their goals is to imitate someone who seems to attain those goals. In school, teachers who demonstrate interest, enthusiasm, and desirable habits may encourage the development of these characteristics in others.

In more direct guidance of learner exploration and activity, information is given, methods of work are suggested or demonstrated, and students are prompted to help them identify and overcome difficulties. Just how much direct guidance should be given the learner, and when and in what form, are fundamental problems in teaching.

In the newer curricula for science subjects students are not always given the important generalizations that they are to learn. They are expected instead to draw their own inferences from specific data or problems. Although it is quite unreasonable to expect students to rediscover all knowledge in this way, the attitudes and skills of independent inquiry are important educational outcomes. Therefore, *some* opportunity should be given students at all educational levels to know the excitement and learn the values and methods of relatively independent inquiry and problem solving. This can be done when we are concerned primarily with teaching *how to discover* rather than with the most efficient means of developing an understanding of accepted facts and relationships.

When teaching for discovery, help should be given in a form that requires some activity on the part of the student rather than making such activity unnecessary. We would not tell a learner the answer to his problem, but we might refer him to a good reference book or ask him a thought-provoking question. Increases in teacher assistance of this type result in quicker and surer inferences from experience without eliminating the essential features of discovery methods. The learner still searches and the final inferences are his own. Needless to say, real problems for which no one knows the answer are the most challenging. There is often little thrill in "discovering" the teacher's answer. More mature learners are prone to regard this type of activity as a guessing game and to urge the instructor to get to the heart of the matter and explain what it is they should know.

Direct guidance may be most effective in the initial stages of new learning—for example, in the initial attempts of a student to memorize a poem, to discover a theorem of geometry, or to acquire a new skill. The usual recommendations for teaching a motor skill, such as typing, sewing, drawing, or driving, are: first, introduce the learner to the task and his equipment; second, explain or show him how he can tell how well he is doing; then, demonstrate or explain the skill. All this is guidance. At this point, however, the learner should attempt the task himself. Thereafter, guidance becomes relatively less important, and the consequences of the learner's attempts become more important. The instructor's role shifts to that of a monitor and evaluator.

Flexible, creative exploration is essential to continued success in learning. Originality in children's thinking is encouraged by simply showing an interest in their more novel ideas and listening to them. Novel approaches are encouraged also when students are led to put aside criticism and evaluation for the moment and "brainstorm" for new ideas. Long-term projects to which students return again and again have merit for promoting the "incubation of ideas" so frequently described in accounts of the work of famous scientists and inventors. Most important of all, perhaps, is the challenge of divergent ideas or questions from the teachers. "What difference would it make in our lives if the sun rose in the west and set in the east?" and "What would you do if you were a red jelly bean and wished to be a black one?" present something of a contrast in questions of this sort, but both have been used to spark the imagination of children.

To prevent a loss of originality or flexibility in exploration and activity students should always be urged to seek and use a variety of methods in their work. An emphasis upon a formula or one efficient method of solution to problems, or a series or problems to be solved in the same way, blinds students to equally good or better alternatives. Luchins (1942) demonstrated this clearly with a set of water-jar problems.

Students first worked a series of problems on the pattern of the following example: Get 100 quarts, given Jar *A* holding 21 quarts, *B* holding 127 quarts, and *C* holding 3 quarts. This can be done by filling *B*, filling *A* from *B*, and then filling *C* twice from *B*. In terms of a formula the method may be described as *B-A-2C*. When these students were later asked to get 20 quarts using vessels holding 23, 49, and 3 quarts, they used the same formula blindly. They might have simply filled the 23-

quart vessel and measured out 3 quarts—that is, used *A-C*. Worse yet, they persisted in their attempts to use *B-A-2C* to get 25 quarts when given a 23-, a 76-, and a 3-quart jar. It cannot be done this way, of course.

Luchins suggested that such inflexible attitudes are developed in schools because they stress obedience and encourage competition. Other investigators have been able to encourage flexible, adaptable attitudes and responses, however, by warning students not to stick to obvious methods, by instructing them to look for "new" methods, and by asking them to find and use a different method with each of a series of problems.

THE LEARNER'S REACTION TO CONSEQUENCES

When a learner attempts a goal, the most important consequences are those that indicate how well he succeeded and how he might do better still. These indications provide feedback, knowledge of results or other stimuli that allow him to check and redirect his action. In addition to being informative, the consequences of an act may either encourage or discourage its repetition because they are pleasant or unpleasant. When this happens, reinforcement is said to occur. In the practical management of consequences reinforcement and knowledge of results are often inseparable.

When a learner achieves success and attains his goal, the learning sequence may be considered complete. From one point of view he has gained new knowledge of what leads to what; from another, he has merely acquired a tendency to respond which will affect his action in the future. He may now turn to different goals. What about those cases where he does not turn away, however, but does much the same thing again?

Many situations call for practicing an act after we know how to do it. In these situations we may think of learning how to do the act as merely a subgoal on the road to greater mastery. Hence, trials, not mere repetitions, continue until we are satisfied with our skill or become discouraged. Even more often, perhaps, our goal is the reward a performance brings us rather than the skill itself. Consequently, we continue to perform as long as we get the reward. Performing for extrinsic rewards may be more like piecework than learning, but our understanding or proficiency still improves if we try to get each reward as quickly and easily as we can. The dangers in excessive dependence on extrinsic rewards in the classroom were examined earlier in relation to motivation and goals.

By manipulating the consequences the teacher confirms or sustains learners' efforts to attain worthwhile goals, helps them to overcome difficulties, and encourages desirable attitudes. He does this most efficiently when he can react to each individual's efforts independently. Much of the time he must work with class groups, however. Then, his response to the student who recites aloud or acts overtly may also affect others of the class who are reacting silently or covertly. There is evidence that students do learn from consequences experienced vicariously as they observe others. The process is undoubtedly quite inefficient, however, for not every student acts covertly, and not all of those who do, need or merit a similar response from the teacher.

Even a little vicarious reinforcement or feedback is a godsend for teachers. They find another in the fact that the consequences of a learner's act spread to the learning of the actions leading to the act. A successful recitation may be preceded by the study of the text, self-recitation, making notes, attending to the teacher's question, or volunteering an answer. Commending the recitation encourages the preparatory activities also, thus multiplying the effectiveness of the teacher's reactions.

There is more disagreement among theorists about *why* consequences affect learner's behavior than about *how* they do. It is generally agreed, for example, that learning proceeds better with positive consequences (satisfaction, praise, reward, or knowledge of success) than with negative ones (dissatisfaction, reproof, punishment, or knowledge of failure). Knowledge of success or progress is an especially effective reinforcer with students of all ages and all levels of ability; and, as noted in relation to motivation, it can often be made available to all. When each student's achievements are compared to his own previous work to show his progress, most students receive encouragement; but when each student's achievement is compared to that of others or to an arbitrary standard, relatively few do.

Punishment, beyond the mere indication of an error, is of uncertain value. A student is unlikely to do what the teacher will surely punish, but what happens when the teacher is no longer present? The experimental evidence indicates that mere nonreinforcement is often more effective than negative reinforcement in permanently eliminating an undesirable response. There is an important qualification, however. Mild punishment can help us *change* a response whenever a clear alternative leading to a reward (success) is open to the learner. When correcting students or their work, the better response should always be shown as well as the error.

Knowledge of results and other consequences are most effective when they are given promptly and when their relation to the acts they are intended to encourage can be made clear. Consequences that are too long delayed lose much of their value to the learner if he is no longer motivated or if he is unable to connect the results with the specific acts that caused them. Students frequently need to be helped to find the specific causes of consequences. Praising a student's writing, for example, encourages him in one way or another; but, unless we praise his originality specifically, he may only learn to use more commas.

It should be evident that students seldom learn what teachers do not evaluate at all. When there is no response to students' efforts to be creative, for example, such efforts usually cease. Because high school and college teachers are usually indifferent to the quality of students' penmanship, it does not improve. If teachers' tests require nothing but the recall of specific facts, they should not be surprised when students are unable to use these facts for the solution of problems.

Consequences also affect the attitudes of learners in important ways. Success and recognition for success, when deserved, encourage positive attitudes toward the teacher, the course content, and education in general. On the other hand, failure and punishment for failure, especially when the student believes he is doing his best, make for generally negative attitudes. Failure is sometimes deserved, of course, and it need not always be avoided. Occasional failures seldom disturb the rapid learners, the well adjusted, and the extroverted, for past successes appear to help them develop a tolerance for difficulties. By putting satisfactory progress within the reach of all and by making the penalties of failure less severe or traumatic, we may hope to encourage healthy reactions to failure in most students and forestall emotional responses that interfere with learning and promote negative attitudes toward further learning.

RETENTION OF LEARNING

Acts or knowledge do not automatically become a permanent part of our behavior, readily available for use at any time in the future. We continually act and react as we face new situations, but we may just try to succeed at the moment. Any new learning may interfere with or replace the products of previous learning. Also, some products of learning may be so definitely associated with the specific situation in which they were acquired that they are not used or usable in other situations that differ in the slightest way. For these reasons and others it is often necessary to take definite steps to insure an appropriate permanency and generality for learning. This section will be concerned primarily with the permanency of original learning. The generality of learning, or its transfer to new situations, is the topic of the final section of the chapter.

Conclusions from research on the adequacy of the retention of school learning vary with the way it is measured. The ability to recall or independently reproduce the products of previous learning declines more rapidly and reaches a lower level than the ability to recognize the correctness or the significance of previously learned symbols when we encounter them later. The difference in the demands of recall and recognition tests are well-known to every student. Still another way to measure retention is by the "savings" or reduction in the time required to relearn material or skills when we need them.

The familiar "curve of forgetting," which declines very rapidly at first and then levels off at about one-fifth of the original learning in just a few hours or days, presents the "facts" of retention in a rather discouraging light. Such curves are usually obtained by measuring the recall of isolated, often meaningless, associations. Fortunately, there are grounds for greater optimism concerning the lasting benefits of education. In one study the more general outcomes of a college science course—the ability to apply generally useful principles and to interpret experimental results—showed no decline, actually some increase, a year after the end of the course (Tyler, 1933). During the same period the specific facts and technical details of the course were almost entirely lost to recall. Learning the facts may not have been in vain, however, for without the facts the principles might never have been learned. Moreover, we might expect that many "lost" facts could be relearned rather rapidly.

By far the most important factor in retention is the adequacy of initial learning. Hence, the statements on readiness, motivation, exploration and action, and consequences are significant here. Meaning or understanding and positive consequences during learning are especially crucial.

When material or responses are to be memorized, learning beyond the level of a perfect recitation or "overlearning" is often recommended also. A little overlearning is proportionately more helpful than more, however, and the optimum additional practice time or number of trials is probably not more than about one-half of that required for original learning.

The optimum distribution and type of review after learning vary with our purpose. As a general rule, short review periods, scheduled frequently at first and then at increasingly longer intervals, are best. Review periods may be considerably longer for meaningful material than for rote learning, however. As every student knows, even "cramming" or the massing of review just before a test may be effective for the immediate recall of meaningful material. Nevertheless, for continued or delayed retention, spaced review is still much more effective.

Increasing the amount of time spent in self-recitation or efforts to recall independently during review and decreasing time spent in mere repetition or rereading is usually good practice. Whenever verbatim recall is not required, the restatement of facts and relationships in one's own words is preferable.

There is evidence also that our memory is selective and influenced by attitudes, beliefs, and motives. The announcement of a test or other instructions that establish an intent to remember make a difference in both learning and retention. After reading controversial material or listening to a debate, we tend to remember the information that agrees with our beliefs better than that which is opposed to them. Finally, we may find that we have a "convenient" memory, which is inclined to forget unpleasant assignments, debts, and dentists' appointments.

TRANSFER OF LEARNING

All education aims for a carryover from one course or level to another or from school to life, but how is such transfer best achieved? The once popular theory of formal discipline held that transfer was easy. The mind was said to have faculties or powers such as memory and reasoning. Schools sought to strengthen students' faculties by many kinds of difficult mental exercises, somewhat as they strengthened their muscles. Students with trained faculties were expected to excel in a wide variety of school tasks and be well equipped for the problems of life as well.

William James and E. L. Thorndike were early leaders in the rejection of the theory of formal discipline. Their experiments showed that exercising one assumed faculty, memory, with one type of material did not help students memorize another type of material. Furthermore, students of equal ability made about the same gains on mental ability tests whether they took formal discipline courses (foreign language, mathematics, science, and so on) or "informal" discipline courses (shop, commercial subjects, art, and so on). We now know that if the study of Latin is to improve students' English, English vocabulary and grammar must be taught along with Caesar and Cicero; and if geometry courses are to improve students' critical thinking, geometry must be made the occasion for encouraging the use of critical thinking in other situations.

We will end our review of the elements in the course of learning with other presently accepted statements about transfer. The most generally useful of these is that any condition of readiness, motivation, exploration and learner activity, or the consequences of that activity, that improves learning and retention, also increases the possibilities for transfer.

Given superior learning, the degree of transfer from one learning situation to others depends on their similarity for the learner (McConnell).[4] The basis for such similarity may be found in specific facts or in general principles, in isolated acts or general techniques, in attitudes, and in emotional reactions. Courses in each field of study might well be built around those responses of all types that have the most potential for continuing or recurrent usefulness. Then, these responses could be taught as keys to classes of situations, not merely as methods for solving a problem or two or completing an assignment. There are many examples.

---

[4] "Reconciliation of Learning Theories," in N. B. Henry (ed.), *Psychology of Learning*, 41st Yearbook, Part II (Chicago: National Society for the Study of Education, 1942), pp. 275–277.

When a student finds the diameter of a circle whose circumference is three inches by dividing three by the value of pi (3.14), he can also be learning to find the diameter of trees and tanks and even the earth. While this is happening, his instructor may interpret neatness to him as an ideal to be sought in all work, not merely as a requirement on papers to be "handed in."

In literature the study of a poem is often presented as an exercise in memorization or translation; but it could lead to an appreciation of the sensitivity and keener observation of poets and to an understanding of how they and other artists evoke an echo of their responses in others. And in science an experiment could be an occasion for learning the approach and methods of the scientist.

Transfer is not always desirable or helpful, however; it has a negative as well as a positive side. Negative transfer occurs when old learning interferes with new or makes it more difficult. Learning new acts in old situations often presents such problems—for example, when a driver changes from an automatic to a manual or "stick" shift or when a boy finds that teachers prefer "he doesn't" to "he don't." Such confusion is rather easily overcome if the new situation calls for a conscious and deliberate selection from among the alternatives; it is not difficult to learn to match the number of subject and verb on a test. But habits of responding in particular ways are much harder to change. Additional deliberate practice on both alternatives often helps reduce such interference, perhaps by improving our ability to tell when each response is best and by bringing habits under voluntary control.

Any two similar learning products tend to merge or combine. This may be desirable if both are examples of a more general outcome, but if two things to be learned should remain independent, they should be learned separately and at different times. In this connection, teachers often ask about the teaching of *to*, *too*, and *two*. Initially, each of the three should probably be taught separately. Only later should we point out that the same sound is written three ways and show the differences in use and meaning. If the words are confused in further use, better learning of each of the three is again the answer.

1298
S.C.E.R.T., West Bengal
Date 29.4.87
Acc. No. 3982
S.C.E.R.T., West Bengal Library 25/3, B. C. Road Calcutta

2

Contiguity Theories and Education

THE PSYCHOLOGICAL views considered in this chapter and the next regard learning primarily as a matter of habit forming. *Habit* is another term for a *connection* or *bond* that is said to link elements of sensation (*stimuli*) and elements of behavior (*responses*) when these have been associated in our experience. An S-R bond may be formed whenever a stimulus (S) and a response (R) occur together, as contiguity theorists suggest; or some satisfying consequences of the response may be necessary, as the reinforcement theorists say.

S-R theories in the contiguity tradition are the special interest of this chapter. They are introduced by illustrating the effect such views might have on the general orientation of the teacher. Some attention is then given to representative theorists and their research. The final sections of the chapter examine the implications of the contiguity approach with respect to managing the major elements of the learning process.

THE CONTIGUITY PRINCIPLE IN TEACHING

The contiguity view, baldly stated, is that a student *learns* what he *does*. Whatever he *notices* becomes a stimulus or signal for any response that occurs at the same time. Whenever the signal reappears, he does what he did the last time it was noticed. In teaching anything the crucial aspect of method is how to get students to notice and respond correctly at the same time. Ask what the student should notice, what he should do, and

370.15

how can I arrange for him to notice and respond simultaneously. To teach a child to read a printed word or phrase, for example, you would choose one the learner can say and get him to say it while looking at the symbols. When he notices these symbols again, he will tend to say them correctly, for the association (S-R) was formed when the stimulus (S) and the response (R) occurred together. For those situations in which we are able to get learners to make the response we want, if need be by having them copy it directly, the use of the contiguity principle is very clear.

The responses of which we write here are not restricted to observable movements or those the learner may control. The contiguity tradition gives a central role to emotional responses—internal states or tensions which may be labeled fear, rage, joy, and love or milder reactions of like, dislike, "feeling good," or "feeling bad."

The emotional responses must not be dismissed as insignificant. When fear is aroused in the student by demands he cannot meet, this response is associated with all those elements of the school situation of which he is then aware—for example, the subject matter and the teacher. On the other hand, the teacher who makes students "feel good" also helps them to like school and enjoy further learning.

Once a student acts correctly or makes a desirable emotional response, change the situation, at least slightly, before he has a chance to do something less desirable. If the last thing a student says when a word or phrase is presented in a particular way is the wrong sound or an "Aw, I don't know," this may be the response that is learned. The student's *last* response to each situation should be *correct*.

A type of practice or repetition is often necessary, nonetheless. The same situation may never appear again in exactly the same way, and we may wish the same response to occur in a variety of similar but not quite identical settings. In our first example we would want to be sure that the written word or phrase is a signal for the correct response whenever and wherever it appears—in manuscript, on the board, in a book, in a newspaper. Associating the saying of the sound with the written symbol over and over again, but always in a slightly different context, is a way to help insure this.

If a student does do something wrong in the presence of given stimuli, try to intercept this response by other stimuli, perhaps from instructions, that will produce the desired response. When a student cannot find the right word to express an idea, for example, he may substitute familiar but inaccurate ones. If he does, try to catch him in such situations—create them if you must—and assist him in a careful search for words that are both accurate and apt. With some repetition of this pattern the stimulus situation of hesitating over the right word may be reliably associated with a careful and accurate selection, even when there is no teacher prompting.

Another interesting example is described by Guthrie (1942). A girl who never hangs up her coat and hat until her mother nags is made to go back outdoors, come in again, and hang up her wraps as she does so. This proves effective because the stimuli that occur when she comes in the house are now attached to the desired response. The old stimuli from the mother's nagging need not occur at all.

CLASSICAL CONDITIONING

The classical contiguity theory is that of conditioning. A Russian physiologist, Ivan Pavlov (1849-1936), introduced conditioning to explain the results of animal experiments he conducted about 1902.[1] His view, and that of J. B. Watson (1878–1958), a leader among American S-R theorists who made conditioning the basis for all learning, was that learning is the shifting of old responses to new stimuli. It is the result of situations in which stimuli that produce the desired response are paired with other stimuli that do not. After a number of such pairings the initially ineffective or new stimuli become connected with the response also.

Pavlov's experiments have been repeated innumerable times. A typical demonstration of his best-known demonstration of conditioning begins by familiarizing a dog with the laboratory situation and a harness that restrains him. A small opening has been made in the dog's cheek, near the duct of a salivary gland, and a glass funnel cemented to his cheek. The funnel and a connecting tube collect the dog's saliva. A pair of stimulating events are then presented repeatedly. One of these, called the unconditioned stimulus (US), is often the sight of meat powder. Its presentation to the hungry dog elicits a flow of saliva, and the dog is permitted to eat. Another stimulus, hearing a musical tone, has no such effect initially. The tone probably causes a twitching of the ears, but this is ignored. After a number of pairings in which the tone always precedes the meat powder, the tone alone produces saliva. Hence, hearing the tone is termed a conditioned stimulus (CS). The original response of salivation (R) shifts or becomes connected with hearing the tone (CS) as well as with seeing the meat powder (US).

---

[1] Although Pavlov used the term "reinforcement," his reinforcements were given before the learner's response rather than after it, as is usual in the experiments of modern reinforcement theorists. Watson did not use the reinforcement concept.

John B. Watson was attracted to conditioning by the desire to rid psychology of its long concern with an unobservable mind. He rejected the need and ability of psychologists to study more than physical situations and observable responses. He proposed a psychology based on the scientific study of observable behavior and its modification by conditioning. The term "behaviorism" is sometimes applied to this view.

Watson's most famous demonstration[2] was one in which he conditioned Albert, a child of about one year, to fear a white rat. The child was obviously attracted to the rat, but when he reached for it, Watson clanged a metal bar. After this sequence was repeated a number of times, the child feared the rat. This is a classic example of a stimulus (sight of rat) being associated with a reaction (fear) when it was paired with an unconditioned stimulus (hearing clanging noise). Thus, Watson was able to show how some of our apparently irrational emotional reactions may be established.

GUTHRIE'S CONTIGUITY THEORY

Pavlov, the physiologist, worked only with reflexes, those simple automatic unlearned responses. Watson conditioned emotions as well. But E. R. Guthrie, of the University of Washington

---

[2] J. B. Watson, *Behaviorism*, rev. ed. (Chicago: University of Chicago Press, 1930), p. 120.

(1886–1959), extended the contiguity principle to learning responses of all types. He began by deemphasizing the notion of a response shifting from one stimulus to another. For him all that was necessary was that the response and the stimulus to be connected occur together. Furthermore, only one pairing of the stimulus and the response was thought necessary to give the conditioned stimulus full strength to elicit the response. The major experimental support for this opinion came from his studies of cats escaping from puzzle boxes (Guthrie and Horton, 1946). In a typical experiment a cat would be confined in a box from which he could escape by tipping a post near the center of the floor. When this happened an electric control opened a door through which the cat might escape. The cats adopted remarkably consistent methods of tripping the post. If leaning against the post with his left side opened the door once, on further trials a cat continued to use his left side in much the same way. Only when he happened to tip the post in another way, with his tail, did his approach change. If the tail movement ended his confinement also, it would be repeated in further trials.

According to Guthrie practice or repetition is useful because each repetition attaches a response to a different set of stimuli. This concept has been considered in a previous section. Practice also helps to knit specific stimulus-response bonds together to form the larger units of behavior that we call *acts*. One example is that of playing a song on the piano.

Seeing a title of a song may be a sufficient stimulus for striking the first notes of a song when you are seated at the piano. The stimuli associated with these movements and the sound of the first notes can then be stimuli for responses producing the next notes, and these in turn lead to more notes and finally to the end of the piece. Every connection of this series is not formed at once obviously. When the first is learned, the second must be made correctly in the presence of stimuli associated with the first; the third is made to the stimuli of the second, and so on. The many connections in the complete act are not always formed in just this order either. Incorrect as well as correct bonds occur when mistakes are made, and these must be eliminated or replaced by more adequate connections. In order to avoid disrupting a performance completely when a chance error occurs, still other bonds, something like alternate paths or standby circuits, must be perfected so that the performance can continue. This is an incomplete and simplified account of the contiguity view of learning a complex act, but it suggests the need for practice even though the basic building blocks of behavior may be formed by a single association of a stimulus and a response.

Guthrie is famous for his anecdotes on the control of learning in practical situations. His suggestions for breaking a bad habit are good examples. All of these depend on finding out what stimuli are connected with the undesired response. Keep in mind that internal states as well as external items and events can produce stimuli. Once you identify the stimuli responsible, some other response should be made to occur in their presence or they should be eliminated. One method of substituting another response is by tiring the learner. Present the stimulus object so often that he becomes exhausted and has to change his response. Thereafter the changed response should occur. Guthrie (1942) tells, for example, how a mother cures a small girl of playing with matches by forcing her to light a whole box in quick succession. The girl finally throws them away in disgust. The next time she is given matches she will tend to throw them away instead of playing with them.

A teacher who has students who stop studying whenever he walks about the room might try Guthrie's suggestion of presenting the occasion for an unwanted action along with others that can be counted upon to produce a response that prevents the undesirable one. If this teacher gave his students intensely interesting stories to read, they might hold the students' attention so well that his movements would be ignored. According to Guthrie, the students should no longer have trouble concentrating, because the teacher's movements would now be associated with reading rather than listening or watching responses.

Still another method "sneaks up" on the learner with the stimulus. Guthrie's favorite example is that of breaking a horse by first putting only a blanket on his back. A man would cause the horse to buck, but the blanket is too light, too weak a stimulus. When the horse becomes accustomed to the blanket, a saddle may be added. In this manner the weight on the horse's back can be gradually increased until he will not buck when a man mounts him. This method of introducing the stimulus for an offending response so gradually that the response never occurs is another way habits may be broken.

The contiguity position with respect to the elements of learning, which were introduced in Chapter 1, can now be explained more fully.

READINESS IN S-R THEORY

Any differences between the S-R theories of contiguity and reinforcement with respect to readiness appear insignificant for our purposes. For either contiguity or reinforcement approaches the question concerning a learner's readiness tends to be "Can he make the correct response?" rather than "Will he understand?" Does this mean we may be satisfied with superficial skills and performances only and insensitive to whether or not students can find meaning or significance in new learning? Not necessarily, but this possibility is seen in the priority that S-R theorists give to the simple fact of an acceptable response. It is fair to say that understanding or meaning is given less attention in S-R theory than in cognitive theories (Chapter 4), although both recognize that related previous experience facilitates learning.

Within S-R theory any act complex enough to be of interest in the classroom must be regarded as composed of numerous simpler actions. Long division, for example, requires at least estimating the quotient, multiplying and carrying, borrowing and subtracting, and placing the decimal point. Readiness for a complex response is considered a matter of having previously mastered these simpler components, and a lack of readiness is diagnosed as a failure to have done so. Of course, difficulty may arise from inadequate integration of essential responses or a failure to respond to the internal stimuli that link various overt components of a complex response. Guthrie's explanation of how complex responses can be learned might be reviewed at this point.

We would expect contiguity and other S-R theorists to favor attempts to build readiness for more complex actions by appropriate learning sequences. The current developments in programmed teaching materials find favor with both contiguity and reinforcement theorists. In programming, definite plans are made to lead the learner step by step from initial simple to more complex terminal behavior (Chapter 5).

The analysis of prerequisite abilities is used also in the diagnosis of learning difficulties. Any teacher can observe students' actions and ask them questions to uncover deficiencies in their preparation. Brueckner and Bond (1955) recommend commercial tests of the abilities required for success in several subject areas. They also offer helpful suggestions to the teacher who desires to construct his own informal tests based on commonly observed deficiencies or errors.

DEVELOPING AND USING MOTIVATION

In Guthrie's contiguity theory stimuli are motives. Stimulation from within or without arouses the learner, excites or annoys him, and causes him to respond, perhaps in various ways. When some act of his removes or ends the stimuli, it is associated with them because, as we have noted, it is the last thing done in their presence. The teacher or a text can "annoy" a student by confronting him with a choice or problem. The choice may only be that of answering correctly or enduring the teacher's continuing attention and the knowing glances of fellow students.

We have previously noted that teachers are expected to do everything within their power to help students respond successfully. Students can learn to be more independent, however. Suppose the teacher has to coax or prod a new class of students to keep them paying attention or reacting until they are successful. The learner's instructions to himself or even his emotions may become signals (conditioned stimuli) in a chain of activities that lead to the end of the annoying attention of the teacher. Later, when the learner is again in a position where he is similarly annoyed, his reaction to the annoyance sets off the first response of the chain and the resulting internal "speech" or tensions can keep him going and direct his activity—echoing the teacher, reading, reciting, and so on—until he is again out of the situation. Refer again to Guthrie's explanation of "chaining" in a complex act such as that of playing the piano.

There is a time to teach and a time not to teach. Guthrie is very emphatic about the futility of attempting to teach when your students are absorbed in their own affairs and, hence, unlikely to make the desired response, or when you do not have their attention. You cannot teach when students are disorderly, for example. If you shout at them, you only teach them to be disorderly when you shout (by contiguity). If you call a dog while he is chasing a cat, Guthrie notes, you teach him to run away when you call. The time to teach a dog to come when he is called is when he is already moving toward you. Perhaps we cannot wait until students are already doing what they are to learn but we should avoid becoming the stimulus for their moving away from learning.

Contiguity theorists find too much careless writing about goals.[3] They do not believe that goals and purposes determine activity in any future sense. If we appear to seek particular objects or conditions as goals, this is merely because doing so has been instrumental in removing the cause of our activity on previous occasions.

Guiding Exploration and Action

For a limited range of objectives, the contiguity approach is definite about how the desired response is made to occur in the first place. Any necessary cues, for example, instructions and examples, are used to evoke a response at the right time and place. In learning to associate names with dates and places, or number combinations with answers, or written with spoken words, the teacher presents the first of each pair with instructions such as, "Say after me," or "Make it just the way I do." Then, he provides the second member of each pair, and finally the students respond.

Simply observing a model may enable student's to "copy" skills, attitudes, and other performance accurately. The teacher's example has been called a universal form of guidance in contiguity learning (Bandura, 1962). Instructions, films, and social norms are said to be somewhat similar in their effects. Complex and highly skilled performances are not so easily copied from teacher models, of course. Here instructions and other methods are used to keep the learner active and varying his responses until he gets it right. Guthrie speaks of trial and error behaviors that may lead to a solution.

---

[3] E. R. Guthrie, "Conditioning: A Theory of Learning in Terms of Stimulus, Response, and Association," in N. B. Henry (ed.), *The Psychology of Learning*, 41st Yearbook, Part II (Chicago: National Society for the Study of Education, 1942), p. 52.

Arousing positive emotional responses may be a very important part of the teacher's job also. Contiguity theory suggests that such responses are prompted and learned in much the same way as other responses. Indeed, the teacher might well think of his job as that of attaching positive student feelings to as many aspects of the course as possible. When appropriate opportunities arise or when they have a choice, students may then be expected to seek and use the materials, concepts, and skills of the course because doing so makes them "feel good."

As a sequel to Watson's experiments with Albert and the rat, Mary Jones (1924) showed that some unpleasant reactions can be unlearned later. A young boy who had been taught to fear a rabbit was placed in a very pleasant situation; then the rabbit was brought in. At first the rabbit was only placed in a far corner of the room. Gradually over a period of several days the rabbit was moved closer. Finally, the boy played with the rabbit without a trace of fear. The care taken to prevent the reoccurrence of fear in this example reminds us of Guthrie's proposal for breaking a horse by very gradually increasing the weight on his back. These procedures offer some promise for the elimination of unwanted reactions, but this is obviously much more difficult than eliciting or establishing such reactions in the first place.

MANAGING THE CONSEQUENCES

The important thing about consequences, according to Guthrie, is whether or not the stimuli of the situation have changed. If the stimuli change after a response, that response will be the last associated with the vanished stimuli. Hence, a response is associated with the situation (stimuli) it removes, and if the stimuli reappear the response tends to reoccur also.

The teacher should never allow students to terminate a situation with a mistake. If they do, the mistake will be learned and reappear later as surely as any "right" answer. To insure that this does not happen and that an acceptable response does, the teacher may provide a model for the student to follow or prompt the desired response in other rather direct ways. Punishment and reward may be used. Guthrie states that their efficiency depends entirely on whether or not what they cause the child to do is desirable. "Sitting on tacks," he writes, "doesn't discourage learning. It encourages one to do something else than sit."[4]

Any incentive that the teacher may use must be judged by the effect it has on the learner. Don't forget, however, to include emotional responses in the evaluation. We might force a child to sit on a tack, for example. His response to us would certainly be negative, however, and he still would not sit on a tack voluntarily.

As we have noted, the broader attitudinal and emotional consequences of conditioning and learning are emphasized by all conditioning and contiguity theorists. While the learner solves problems, he is also learning an emotional response to various elements of the situation—tasks, activities, people, and things. When a student's answer brings a sarcastic comment from the teacher, the students may learn more than is commonly assumed. The sarcasm may lead to anxiety or tension, which in turn stimulates withdrawal responses that may prevent a number of students from attempting any answer in the future. The value of this concept is of obvious value, even if the contiguity explanation turns out to be incomplete or invalid.

PREVENTING FORGETTING

For modern contiguity theorists forgetting is simply learning to do something else. The response that ends a stimulus situation is learned; but if that response doesn't work the next time, others are tried. At any given occurrence of a situation, the response that was most recently successful in that situation is the one that is tried first. This is an interference theory of forgetting. We do not lose knowledge or skill by disuse, according to this theory, only by other learning.

We may ask why we ever forget anything useful, if it is always a matter of learning something that works better. The answer is that interference takes place in similar as well as identical situations. If we forget new meanings for words, it is because the words are used again with more familiar meanings. We lose some of our skill in baseball because of competing responses to somewhat similar situations in softball.

---

[4] E. R. Guthrie, *The Psychology of Learning* (New York: Harper, 1935), p. 154.

We may summarize the idea of partial interference as follows: Response *A* is associated with situation *A*. But situation *A* has many stimulus elements—1, 2, 3, 4, 5, and so on. Situation *B* has some of the same elements as *A*, if only a few, say only 1 and 5. If response *B* is now made to situation *B*, the association of response *A* with situation *A* is weakened because elements 1 and 5 are now associated with response *B* rather than with response *A*.

One positive suggestion for teachers has been made. Retention is better if we use a new skill or knowledge in a variety of somewhat different situations. Practice means learning many separate response elements for many separate stimulus elements. If there are many stimulus elements in situation *A* that have been associated with response A, perhaps several hundred altogether, it will probably be repeated when situation *A* occurs again, even if new responses *B* or C have been learned to a dozen or so of these same elements.

Classical conditioning theory, as it was presented by Pavlov, described forgetting somewhat differently and in terms of the repeated occurrence of a response without reinforcement. This is the process of extinction, which will be described in connection with modern reinforcement theories.

ENCOURAGING TRANSFER

Guthrie continually stressed the specificity of learning and was quite pessimistic about the possibilities for transfer. Some transfer might be possible from one situation to another, but teachers were cautioned against depending on it. The only way to be sure that a student will respond correctly to any other situation is to have him practice in that specific situation also. The next best thing, as we have suggested, is to have him practice in a wide variety of situations that are generally like the situations in which performance is expected. This repetition, as explained in relation to retention, is an effort to attach as many specific stimulus elements as possible to the desired response.

The classical conditioning theorists were much more optimistic than Guthrie with respect to the possibility for transfer. Thus, a boy who fears a white rat may fear a white mouse, a white rabbit, or even a bit of white fur. The student, and all too rare he is, that finds his work with an algebra teacher interesting and rewarding also tends to like other mathematics courses and materials, other teachers, and other classrooms. Pavlov's concept of how a response to one stimulus generalizes (transfers) to similar stimuli is more closely related to the explanations of transfer offered by modern reinforcement theorists than to those of Guthrie. Hence, they are presented in the next chapter.

Evaluation and Related Developments

Association by contiguity is one of the most ancient of psychological concepts and one of the most durable. There is no question of its continuing importance in nearly all modern theories, but only those so far noted consider it an adequate basis on which to build a general explanation of learning.

Reinforcement theorists have generally found an important minor role for some contiguity principle within their systems. They have been reluctant to accept Guthrie's "one-shot" learning, however, and they cite experimental evidence that they say refutes his assertion that an act that ends a situation is as likely to reoccur as an act that is rewarded. Other interpretations of these same results were possible for Guthrie, however, because of the loose and rather flexible nature of his ideas. It is just this characteristic of his work that has drawn the most telling criticism. Hilgard[5] suggests that our inability to test Guthrie's theory is sufficient cause for skepticism.

The whole concept of S-R is too unintelligent and mechanistic for cognitive theorists. To understand learning they believe it necessary to start with the learner's perception of whole situations, not the association of bits of experience. Nevertheless, contiguity sometimes helps them explain how the features of the learner's environment can acquire significance for him.

The contiguity principle continues to attract a number of psychologists who are currently active in research on learning. The relative simplicity of the contiguity principle has made it attractive to a number of psychologists attempting to achieve greater precision and rigor in the study of learning through the application of statistical methods.

---

[5] *Theories of Learning* (New York: Appleton-Century-Crofts, 1956), p. 78.

The "rules" of programming used in preparing materials for teaching machines (Chapter 5) are also closely related to contiguity principles. The programmer's principal problem is to get the learner's response attached to the right stimulus context. Lumsdaine (1964) believes Guthrie's explanation of conditioning by contiguity to be the best explanation of how this is done. As he sees it, the procedure is that of prompting the response in the right context and not, as some others believe, the manipulation of reinforcement after a response.

A theory may be evaluated by its continuing influence in psychology; contiguity theory seems to be meeting such a test. It may be evaluated also in practical situations; and several circumstances or ways in which contiguity theory promises to be useful, at least in forming hypotheses about educational practices, have been suggested. After presenting the emphases of reinforcement and cognitive theories, we will examine the use of the contiguity principle in several instructional contexts.

S.C.E.R.T., West Bengal
Library
Calcutta
25/3, B. C. Road

3

Reinforcement Approaches to Learning

As S-R APPROACHES, reinforcement theories suggest several of the same emphases that have been described for contiguity theories. Traditionally, however, there has been less emphasis in reinforcement than in contiguity theories on the control of stimuli *before* responses occur and more on the control of the consequences that *follow* responding. The learner is described as active and responding on the basis of natural or previously acquired tendencies. He may do a number of things. Responses that are followed by satisfaction or some equivalent are reinforced and become more probable in the future; those that are not are weakened and so are less apt to occur again. Thus, learning may be described as a process of selecting and confirming responses.

Reinforcement in Teaching

The teacher guided by the concept of reinforcement seeks to create a situation in which students are apt to make a correct response. When this response occurs, he uses his most powerful tool, reinforcement. Informing the learner of his success or failure may be all that is needed, but several forms of reward or approval are commonly used also. At the same time the teacher seeks to discourage incorrect responses by withholding reinforcement.

Reinforcement theorists have not been entirely consistent with respect to how to get learners to respond correctly in the first place. In the laboratory the reinforcement theorist favors a learning situation in which the learner is free to vary his response. Certain responses are selected for reinforcement, but "errors" are expected. On the other hand, the early reinforcement theorists counseled against permitting unnecessary errors in school learning, and more recent ones advocate educational practices that make errors very improbable. Reinforcement psychologists who prepare programmed materials, for example, try out and revise their programs repeatedly in an effort to eliminate errors.

There is little chance for error in the following excerpt from a learning program: "The prefix *trans-* means 'across' or 'over' so a transatlantic flight goes _____ the Atlantic." In further items (frames) the information given would be reduced gradually, until the learner could give the meaning and use the prefix with little or no assistance. In effect, the same procedures suggested by contiguity principles (the equivalent of a teacher's "Repeat after me . . .") are used to increase the probability of an initial response. Then, there is a gradual shift to free response procedures (the equivalent of a teacher's "Who can tell me what . . .") and the selection of responses by reinforcement.

The selective role of reinforcement is clearer when we are *not* too successful in eliminating errors or getting learners to respond as we want them to. There are many such occasions. Telling or showing is not enough to enable students to write legibly, color neatly, dance gracefully, sing sweetly, throw accurately, or drive safely. Errors in following procedures, reasoning, and judgment occur in spite of our careful plans and explanations. We don't know much about how to get students to pay attention or concentrate. In these and other situations repeated tries by the learner are necessary. Then, reinforcement may be used to encourage good tries and discourage poor ones.

The plan of the remainder of this chapter is similar to that of the preceding chapter. Several major theories are described briefly; then reinforcement emphases are explained more fully.

THORNDIKE'S CONNECTIONISM

E. L. Thorndike (1874–1949) was the first of the major reinforcement theorists. His *Educational Psychology* (1913) stimulated efforts to uncover facts about learning, and for many years thereafter, Thorndike was a leader in the application of psychological knowledge to education.

Although the major part of Thorndike's research was with humans, some of his early work with cats will serve as a clear introduction to his views. In a typical experiment a young and hungry cat was placed in a slatted box with food outside. The cat threshed about wildly, clawed, bit, and scratched at every part of the box. When he chanced to pull a string (or hit a button), a door would open and he could eat. In repeated trials, the cat very gradually ceased his wild ineffectual movements. Finally, when placed in the box again, he would immediately claw the loop (or button) to win his release and food. Thorndike's extensive observations in this and other experimental situations led him to conclude that learning the effective response was largely accidental. Through trial and error, the stimuli (S) of the puzzle box were connected with the response (R) that won release.

Thorndike's further work (1913, 1932) led him to state the important *law of effect*. This law held that any S-R connection will be strengthened if its formation and occurrence are satisfying. Repetition alone, he concluded, will not strengthen a connection; it only makes it possible for the law of effect to do so.[1] In his earlier statements he supposed that annoying effects weakened bonds just as satisfaction strengthened them. Later, he concluded that this was not so and that the effects of annoyers or punishment are unpredictable and, hence, not very useful.

Thorndike did not believe all stimuli are concrete and all responses movements. In human learning a thought or idea may be either a stimulus to action or a response. Further, both stimuli and response may be internal, and a bond can be between two unobservable cognitive or emotional elements. Interests, ideals, emotions, and complex skills were explained in terms of groups of interrelated connections.

THE INTERPRETATIONS OF HULL AND MILLER

Neal Miller's (1909–) reinforcement theory is essentially a simplification of Clark Hull's (1884–1952) and will serve our purposes as well as that more elaborate and formal system.

---

[1] E. L. Thorndike, *Fundamentals of Learning* (New York: Teacher's College, Columbia University, 1932), pp. 62–63.

There are four central elements in Miller's approach: *drive, cue, response,* and *reward.* Drives stimulated by internal or external conditions impel the learner to act or motivate him. Cues are stimuli in the situation that limit or determine how one acts in response to a drive. A hungry man may pick an apple, go to the cupboard, or enter a restaurant. Cues may make the difference. In an unfamiliar situation the responses to a drive may have little direction, of course, and learning is a matter of trial and error or trial and reward.

When a response or responses occur, one of these may reduce the strength of the drive. Eating reduces hunger; drinking reduces thirst; standing reduces the pain caused by sitting on a tack. This drive reduction is a reward. The probability of rewarded responses is increased; that of unrewarded responses is decreased. An increase or decrease in probability may also be referred to as a change in strength or habit strength.

An illustration may clarify the concept of changes in response probability. Suppose you must solve an algebra equation. You have previously had success with (A) adding and subtracting terms on both sides of the equation, (B) multiplying both sides by various terms, (C) a combination of responses A and B, (D) use of the quadratic formula, and (E) wild guessing. The probability of each of these responses depends in large part on how often it has been rewarded in your past experience. Each reward adds an increment of habit strength. Although you may not be aware of it, you would tend to try these several responses in the order of their present habit strength—strongest first, next strongest second, and so on, until you are successful. Suppose D brings success (reward) although you tried A, B, C, and E first. The probability of D for use in future situations of this type increases; that of A, B, C, and E decreases.

You don't learn algebra because you are hungry and rewarded with food, of course. Learned or *secondary drives* and *reinforcers* must be used to account for most human learning. Any stimulus—for example, words, smiles, knowledge of results—can become a secondary reinforcer simply by being present when a primary or unlearned reinforcer is used. We suppose that many such reinforcers are established early in life by being present when infants are fed or comforted. Others have been associated with escape from a painful or feared situation. Once established as secondary reinforcers these words, smiles, knowledge of results, and so on, can reward and strengthen the responses they follow.

Similarly, any object or condition can arouse a drive if it has been present on previous occasions when a primary drive is aroused and then reduced. Suppose a child is punished when he is told to do a task, perhaps because he didn't do it when first told. The pain of the punishment produces the fear and anxiety this time, but by association (conditioning), words of the type, tone, or force that were used to direct him gain the power to produce anxiety also. The drive produced by using these words to assign a new task is said to be *secondary* because it has been learned.

Miller and his co-worker John Dollard have attached great importance to imitation in learning situations. Imitation is merely the use of cues produced by the behavior of others. A tendency to imitate others may be learned when we happen to do what someone else is doing and are rewarded for it. One such incident cited by Miller and Dollard (1941) involves an older boy who runs to meet his father. A younger brother happens to be running in the same direction at the same time and both are rewarded with candy. Running was the response rewarded; but since running in other situations had not been rewarded, the older brother's action became an important cue. As a result of other experiences of this kind, the older's acts become the cues for similar behavior by the younger boy. Of course, this boy probably learns to use other cues that tell him when imitation is not rewarding.

SKINNER'S DESCRIPTIVE BEHAVIORISM

The acquisition of facts and the description of purely empirical relations is the announced goal of B. F. Skinner (1904–) of Harvard University. He is especially interested in controlling responses that seem to occur with no direct stimulation. Such responses seem to be emitted by the organism rather than elicited by obvious stimuli. Walking, talking, working, playing, and, in fact, much of behavior seem to him to be of the emitted type. Since the function of this behavior seems to be operation in or on the environment, he has termed it *operant* behavior.

He then refers to stimulated responses as *respondent* behavior.

Skinner has been enormously successful in controlling the operant responses of rats and pigeons by manipulating reinforcement in a standard experimental device called the Skinner box. This is a small box containing a lever that releases a pellet of food into a food tray and at the same time automatically registers the response on a time chart.

A typical demonstration of operant conditioning might begin by depriving a rat of food until he loses about 20 per cent of his normal body weight. Then, the rat is trained to go to the tray for food. The procedure is to introduce a click, a light, or some other signal that is immediately followed by a pellet of food. After a number of repetitions of this sequence, the signal will cause the rat to go directly to the food tray. In the next stage of training, the signal would be sounded and reinforcement given whenever the rat touches the lever. This is continuous reinforcement and will result in a steady rate of lever pushing.

Reinforcement may be intermittent instead of continuous; and when it is, more responses occur per reinforcement. Resistance to extinction—that is, the disappearance of a response when reinforcement is stopped—is also greater after intermittent than after continuous reinforcement.

An intermittent schedule may call for a reinforcement at either regular or variable intervals of time. Another pattern is to reinforce only after so many responses have been made. Best of all from the standpoint of a high rate of responding and great resistance to extinction is a schedule in which the number of responses between one reinforcement and the next changes constantly.

The most striking phase of Skinner's work with animals is the *shaping* of complex behaviors by systematically rewarding successively closer approximations to the desired behavior. Suppose it is desired to teach a rat to pick up a ball and to shoot baskets. After the rat learned to press the bar of the Skinner box regularly, food would be given only when he touched the ball after pressing the lever. When this pattern is well established, the procedure would be changed so that he would be fed only after picking up the ball. Still later, food would be made to depend upon his moving the ball toward the basket. Later still, he would be fed only if he put the ball in the basket; still later, only when he allowed it to drop into the basket from a slight height; and eventually only when he tossed it into the basket.

Successful shaping of behavior in this way requires patience and a considerable degree of skill. At each stage of the process the new response to be reinforced must be chosen so that it is nearer the terminal behavior desired than the usual response but still enough like what has already been learned so that it is apt to occur fairly soon. The identification of satisfactory secondary reinforcers may be a problem with human learners.

Skinner is like Guthrie in showing an intense interest in applying learning principles to practical affairs. He has played an influential role in the development of programmed learning and teaching machines, which he sees as devices for the shaping of human behavior (Skinner, 1954). He has also applied his principles to the problem of getting psychotic patients to respond to social stimuli (Skinner, 1957), and he has written a fascinating fantasy of a utopian community, *Walden II,* in which his methods are used to shape society (Skinner, 1948).

Skinner's work has been criticized on several technical points, such as conducting his experiments with very few subjects and relying on inspection of learning curves rather than quantitative methods. Despite his far-ranging extrapolations to the control of complex human behavior, his research program has been rather narrow, concentrated on only a few experimental situations.

DEVELOPING AND USING READINESS AND MOTIVATION

The problem of readiness within S-R theory is a matter of the ability of the learner to respond appropriately in the learning situation. The treatment of readiness in Chapter 2 applies equally well to reinforcement or contiguity views; therefore, our concern in the remainder of this section is with motivation.

A reinforcement theory assigns the teacher an important role in arousing students to activity toward worthwhile goals. Traditionally, a generalized anxiety akin to fear has been considered the master motive. Hull and Miller made the reduction of anxiety and other aversive drives the basis of all reinforcement. For these theorists the deliberate arousal of anxiety is desirable if it is not excessive or long-lasting, and if it can be reduced after appropriate behavior by the learner.

We have explained how a variety of originally neutral stimuli of the physical or social environment, including the teacher's words and actions, can become stimuli for anxiety. Other stimuli may be made the signals and cues that tell us what to do to reduce anxiety. To take a simple example, "teacher at board" may become a signal for paying attention rather than doing something else, such as reading the text. This only happens, however, when ways are found to insure that paying attention at this time does reduce anxiety frequently.

A variety of more recent experimental findings have forced the conclusion that we should give at least equal attention to Thorndike's and Skinner's views that satisfying activities tend to be repeated. Opportunities for these activities appeal to the learner's curiosity or desires to explore and be active. They attract learners rather than annoy them; and as a result, the emphasis on anxiety and other aversive drives is being questioned widely. It is undoubtedly more ethical, and probably less risky, to arouse positive motives, when these are available, than to deliberately play on students' fears.

Once some action in a given situation quiets a drive or brings satisfaction, it is sought again. As in contiguity explanations, the learner who appears to have purpose or seek a goal is said to be merely repeating previously rewarded behavior.

GUIDING EXPLORATION AND ACTIVITY

In the practical management of learning, reinforcement psychologists usually join those with contiguity views in recommending (1) the analysis of new learning tasks into small steps to be mastered in a predetermined sequence and (2) large amounts of teacher guidance to prevent unnecessary errors. Psychologists of both groups consider an actual response by the learner crucial. The reinforcement approach is distinctive, however, when learners need some freedom of response for effective learning and when there is, consequently, possibility of errors. We will suggest the use of reinforcement principles in three important situations.

The first of our examples occurs when a student's behavior is to be shaped to that desired through rewarding successively closer approximations. This is done in teaching writing, dancing, adjusting a microscope, participating in a discussion, or operating a lathe. The learner's overt attempts to do the adequate thing in such skills and procedures need to be monitored closely. Any movement or reaction in the right direction is reinforced. Thereafter, further deviations that conform more closely to the behavior wanted are selected for reinforcement. The teacher must know the final behavior desired, but he does not insist on any particular sequence or pattern of development.

The second situation occurs whenever teachers find confusion among students as to when to use the responses available to them. They may not know whether to use "was" or "were," when a product matches a sample, or when a deduction follows the rules of logic. When this happens, a free-responding situation may be introduced in which correct responses are encouraged by reinforcement, while incorrect ones are discouraged by nonreinforcement. Thus, a *discrimination* is learned.

Our third illustration concerns the teaching of concepts and principles. Many concepts are abstractions that apply to a class or group of objects, organisms, or qualities. "Rat" is one example. "Animal" is the symbol for a more general concept. "Life," "small," "quick," and "white" are others. Learners who have an adequate background of experience can be helped to clearer, sharper class concepts by recalling more specific things known to them that do and do not fit a given concept. Thus, a more adequate concept of animal might be developed among children who are motivated to suggest examples of living things by reinforcing responses that name animals and not reinforcing the names of things in other classes. As large a variety as desired can be suggested or accepted as responses. Members of other classes of things can be suggested in such a way as to improve discriminations.

Generalizations or relationships among familiar concepts can be taught similarly. One common procedure is to state the generalization as a rule. Then, as many examples as are necessary to establish both its generality and its limitations are introduced.

Learners are reinforced for recognizing and/or supplying additional examples.

MANAGING THE CONSEQUENCES

Reinforcement theories are positive about the importance of consequences in learning. Consequences that are reinforcing have the quality of rewards, and they increase the probability of the behavior they follow. These points have been made again and again in previous sections. Reinforcement is the central principle of the theories considered in this chapter, and no attempt has been made to avoid or postpone consideration of its role. Several additional points will be made here.

Chapter 1 suggested that reinforcements that are a natural part or result of activities are preferable to extrinsic rewards, such as marks, awards, or money. The tendency of many reinforcement theorists is to concentrate, however, on what the student learns to do. When rewards are assumed to drop out of the picture anyway, any effective reinforcer may do as well as another.

When knowledge of the results of one response are an important guide to forming the next response, the reinforcement of every response—that is, continuous reinforcement—is probably best. This is the case in the beginning phases of most learning; but for most purposes, and particularly when extrinsic rewards are used, it is probably better *not* to reinforce every occurrence of desired responses.

When rewards have been continuous, the responses frequently stop if the reward does. A pattern in which reinforcements are administered fairly often but not always and at random intervals has shown more promise for establishing responses that persist even after rewards are few and far between. This pattern is suggested for trial use in establishing attitudes, work habits, speech patterns, originality, or other characteristics that should become a permanent part of a student's personality. A teacher has some of his best opportunities to reinforce in this way when students are working independently and he is free to observe and help them individually. The problem may be to find occasions to reinforce each child frequently enough to do any good.

Reinforcement theorists offer some encouragement for those of us who find learners slow to change. Each time we reinforce a correct response and ignore an incorrect one, the former is said to become at least slightly more probable, the latter less so. It is a matter of "each little bit helps." If we keep making a child say "excuse me" when he leaves the table early and reward him each time for the effort, sooner or later he will say it without prompting. He may be learning even though it doesn't show.

Reinforcement views discourage the punishment of wrong responses under most circumstances but are in accord with the generally accepted views of Chapter 1. We are warned, of course, that neutral objects, persons, and activities present during severe or continuing punishment may themselves be greatly feared.

PREVENTING FORGETTING

Extinction, or the disappearance of a response following its occurrence without reward, is the most popular explanation of forgetting among reinforcement theorists. The interference of later learning is recognized as a problem of transfer that is responsible for much forgetting also.

Extinction is the basis of the principle that responses that are best forgotten should be ignored. This is good advice for the treatment of temper tantrums, tattling, and exhibitionism in small children. The mistake that most parents and teachers make in attempting to use extinction is to reinforce such behavior occasionally; and that, as we noted in the previous section, may be just enough to make it resistant to extinction. Punishment does not lead to extinction but may suppress a response temporarily. Sometimes we can take advantage of this respite to teach something that will replace the unwanted behavior.

Retention and a resistance to extinction are similar concepts in reinforcement theory. They depend on motivation and the number and pattern of reinforcements during learning. We can promote the retention of desirable responses of all kinds by making sure they occur and are reinforced as suggested in the preceding section.

ENCOURAGING TRANSFER

Every theory of learning must account for the fact that previous learning makes it easier or harder to learn new things. The theories presented here expect transfer between two learning situations when there is some equivalence of either stimuli or responses. Responses that bring reinforcement may originate in transfer, and they may influence future learning through transfer.

Teachers are advised to "spell out" their objectives in terms of (1) the situations students will encounter in the future and (2) the responses students should make in these situations. To take full advantage of the possibilities for transfer they should then (1) introduce learning materials and tasks that clearly resemble expected future situations and (2) reinforce responses that have some of the important elements of the responses needed in these situations.

The optimum conditions for transfer are believed to occur when two learning and transfer situations call for identical responses to identical stimuli. Substantial transfer—the preferred S-R term is *generalization*—is expected, however, when stimuli or responses are merely similar. The generally accepted principle that transfer from one situation to another is roughly proportional to the similarity between the two situations was suggested in Chapter 1.

Overgeneralization occurs also. There are many dramatic examples. The favorite is probably that of the child who calls every large male "Daddy." Fortunately, we can learn to respond to only one of two or more situations even though all are closely similar; the learning process, which we have already met, is called *discrimination*. The teacher's responsibilities include identifying the possibilities for maladaptive generalizations of a response. Then, he tries to enhance the differences between "yes" and "no" situations by arranging to elicit and reinforce the response in the former and systematically extinguish it in the latter.

The process of concept formation described in relation to guiding exploration and activity is a powerful tool for transfer. We are apt to respond in much the same way to all objects that fit one's concept of "dangerous things." All things that fit our concept of "nice" bring somewhat similar reactions, although they may be as varied as sugar, spice, and little girls. We might say they have an acquired equivalence. To the extent that teachers can help students develop adequate concepts or to classify and usefully equate different objects, persons, or events through words or other common clues, they widen the possibilities for transfer.

When a stimulus situation that we have previously experienced or its equivalent reoccurs, we are not limited to responses previously reinforced in that situation. Other similar responses may occur also. In other words, there is response generalization as well as stimulus generalization.

The formation of learning sets or "learning how to learn" is one of the newer developments that is helping S-R theory adjust to the trend toward recognizing some more general forms of transfer. One way that students may "learn how to learn" is illustrated by the experiments of Harlow (1949).

Harlow taught monkeys to find food by choosing one of two objects on the basis of a difference in color, size, or shape. The monkeys required a number of trials to solve their first problem of this type—for example, to learn that food would be found under the white object rather than the black, or under the cube instead of the cylinder. After long experience with a variety of such problems, the monkeys readily solved still other choice problems, even those in which the placement of the food was reversed, with very few errors. It is as if they knew what to look for. We may say that they acquired a set for solving this type of problem.

The importance of the formation of learning sets is that it suggests that students' ability to solve whole classes of problems may be developed by practice in a series of previous problems requiring the use of the same principle. A somewhat related suggestion, which was discussed under guiding exploration and action, is that we arrange to repeatedly reinforce students for desirable attitudes, work habits, or other generally useful responses in the presence of distinctive cues. In the future these cues may prompt appropriate behavior in a variety of situations. Methods of developing sets to learn the principal varieties of learning may be a key factor in the school's ability to prepare students to cope with the tremendous expansion of knowledge in all fields.

EVALUATION AND RELATED DEVELOPMENTS

Reinforcement theories of learning have been dominant and traditional in American psychology since the days of E. L. Thorndike, but the practical contributions of psychologists identified with this position have varied greatly. Thorndike's impact on the schools of his time and since has been tremendous. He provided scientific bases for far-reaching reforms in curricula and teaching methods. In contrast, the scientific concerns of more recent reinforcement psychologists have often led them to choose artificially simplified problems and conditions and to deny any interest in or responsibility for the practical affairs of education. Miller and Skinner are exceptions, of course.

For our purposes the outstanding recent developments in reinforcement theory are those that have led to the wider acceptance of some of the emphases of contiguity and cognitive theorists. A number of reinforcement theorists including Kenneth Spence, a leading interpreter of Hull, have found the contiguity principle increasingly attractive. O. H. Mowrer, who has been known for his attempts to integrate reinforcement and contiguity theory, now believes learning to be essentially Pavlovian conditioning. The role of the teacher is said to be one of helping to make every wrong response a conditioned stimulus for an increase in anxiety and every right response a conditioned stimulus for the reduction of anxiety. If this is done, our behavior will be correctly "steered" by these *signs*, as he calls them, of fear and hope. Every time we start to make a wrong response we will become more fearful and try something else. If the new response is right, it reduces our fear, we are hopeful, and continue with it.

Recent reinforcement emphases also present alternative explanations, and perhaps implicit acceptance, of some cognitive views. There is the increased recognition of purposeful sounding motives such as curiosity and exploration, already mentioned. The concept of internal "mediating responses," which can come between the observed stimulus and response, has become popular. As a mediating response, thinking may be merely subvocal speech, as Watson believed, which we use to tell ourselves what response to make to a stimulus. Such speech is a response to an external stimulus; at the same time, it makes a difference in how we respond.

Mandler (1962) believes covert replicas or counterparts of our actual behavior patterns are learned and can be used as mediating responses in problem solution. Given many internal structures, each corresponding to a previously learned way of acting, we may be able to shift from one to another while exploring new problems "cognitively." In somewhat the same vein, Resnick[2] states that teachers may discover how to teach students to think by having them rehearse a series of responses which are then speeded up and internalized. We may be able to teach expert thinking by the same methods we use to teach golf or tennis!

Thus, S-R theorists have sought to show that the processes described by cognitive theorists are really the result of the learner's past experience. But Hilgard[3] tells us cognitive theorists themselves have never really denied this. Their point is that past experience will be more useful if new situations are presented so that the learner understands that this is true.

---

[2] "Programmed Instruction and the Teaching of Complex Intellectual Skills: Problems and Prospects," *Harvard Educational Review,* 33 (1963), p. 456.

[3] *Theories of Learning and Instruction,* 63rd Yearbook, Part I (Chicago: National Society for the Study of Education, 1964), p. 61.

4

Concepts from Cognitive Theories

The cognitive theorist gives intellectual processes an important role in learning. He speaks of changes in perception, knowledge, or purpose, rather than of changes in behavior or responding. He may accept conditioning or reinforcement explanations of involuntary reactions and a few motor responses, but he considers a more intelligent form of learning characteristic of man.

A COGNITIVE VIEW OF TEACHING

How would a cognitive viewpoint affect you as a teacher? You would, first of all, see teaching as developing understanding or insight, not as eliciting and reinforcing responses. You would select tasks suited to the natural development and background of your students; and you would present these tasks in common-sense units and in such a way that their essential features are more evident. You would help students relate these tasks to their own short- and long-term goals; and you would encourage them to discover relationships that they might use to anticipate the consequences of their tries.

Every new situation is to be considered a problem for the student who doesn't know how to get from what is given to his goal. This is true whether the task is identifying new words, applying social concepts, writing a good description, sketching a scene, or solving an equation. The teacher's job may be seen as that of helping the learner interpret these situations so that he may see, or at least hypothesize, what leads to what and how to reach his goal. At this point he has learned. When he tests his new learning, either overtly or covertly, the consequences may confirm his hypothesis, and this is an achievement more desired than external reward. If he fails, the teacher helps him to reinterpret the situation and try again.

GESTALT PSYCHOLOGY

At the beginning of the present century traditional psychology was under attack in both America and Germany. In America, Thorndike and Watson were leading psychologists away from the study of conscious thought to the study of behavior. In Germany (later in America), Max Wertheimer (1880–1943), Kurt Koffka (1886–1941), and Wolfgang Köhler (1887–) became dissatisfied for another reason. They considered man's inner processes the proper study for psychologists, but they considered a search for the "atomic structure" of either mind or behavior a waste of time.

Wertheimer and his colleagues denied that everything we see or think about is put together of tiny pieces like those of a jigsaw puzzle. Instead, they said, we perceive and think of wholes. It is often difficult, sometimes impossible, for us to break down into smaller parts what we see or think. Our perceptions of the world and of our thoughts are meaningful wholes that are different from and more than an accumulation of lesser sensations, images, or ideas.

This new German view became known as *gestalt psychology*. Gestalt suggests pattern, shape, or configuration. The gestaltists believe that we react to the pattern of our own inner perceptions. When confronted with a problem, we learn, not by associating bits of experience, but by forming new gestalts—that is, by seeing new patterns in the total situation. As may be seen, the gestaltists are concerned primarily with the learner's knowledge or understanding of rather large segments of life. To them the concept of S-R is too unintelligent, atomistic, and mechanistic.

When we are struggling with a problem, the solutions may come to us suddenly. All at once we see the situation in a new way, perhaps with a feeling of discovery or understanding. This quick change in our gestalt is called an *insight.* Köhler illustrates insight in the *Mentality of Apes* (1925), and Wertheimer's *Productive Thinking* (1959) describes its occurrence in the problem solving of children.

Köhler conducted his experiments with apes while a prisoner on the Canary Islands during World War I. In one experiment a banana was placed outside an ape's cage. The hungry ape was given two sticks, each too short to reach the food. The two sticks would reach the food, however, if joined like the sections of a fishpole. No amount of trial and error behavior seemed to provide a solution for the ape. When the solution did come, it often occurred suddenly, like a "bright idea." As often as not, this happened after a period of time during which there was no attempt to reach the banana. Thereafter, the ape was able to solve this particular problem without hesitation. There was no evidence of the gradual elimination of errors. On the contrary, the ape's behavior seemed to fit the description of insight—that is, the sudden perception of a pattern that includes a way to reach the goal.

One of the problems Wertheimer used in his study of insight and understanding in children required them to find the area of a parallelogram. First, he showed them how to find the area of a rectangle by dividing it up into rows and columns of equal squares. Finding the area, Wertheimer emphasized, should not be a matter of mechanically multiplying the base times the height. He tried to make sure the children understood why this was true by showing them that the area really was the number of squares in a row multiplied by the number of rows.

Later, when Wertheimer asked the children to find the area of a long narrow parallelogram that he cut from paper, some children tried to apply the rule learned with rectangles and were completely baffled. A number of insightful solutions occurred, however, as the children saw that the parallelogram could be "restructured"—that is, changed into a rectangle by filling out one slanted end with a piece from the other end. Wertheimer believed that too many schoolteachers foster the blind repetition of rules rather than the true understanding of situations which encourages later insights.

Gestalt psychologists have found evidence for a number of factors that influence what we perceive. A learner invariably imposes some structure of his own on a situation. Regularly spaced dots, for example, are seen as a line (. . .), a triangle (.˙.), or a square (::), seldom as only dots. Any perception also has a "figure" that stands out and an undifferentiated background or "ground." The print of this book is figure, the paper ground. When we listen to music, the melody is usually the figure. In class, the teacher's voice may be figure at first; then it fades into the ground as our attention wanders.

The gestaltists suggest that the laws of perceptual organization are also principles of learning. These laws help to explain why some insights occur and some do not. The *law of similarity* suggests that similar words or number pairs are easier to associate and recall than dissimilar ones. The *law of proximity* suggests why Köhler's apes found it easier to join two sticks to reach a banana when the sticks and banana were placed nearer each other. In learning, the *principle of closure* is a little like that of reinforcement. Solving a problem or completing an activity brings closure. The problem, the goal, and the method of solution are now part of a unified pattern. From this point of view, the learner's perception is incomplete as long as his goal eludes him. The *law of prägnanz* is basic to all the other laws or principles. It tells us our perceptual patterns always tend to be simple, regular, and complete with no "loose ends."

FIELD PSYCHOLOGY AND SIGN LEARNING

The *field psychology* of Kurt Lewin (1890–1947), like gestalt theory, is a way of viewing and thinking about the individual's perception of himself and his environment. At any given time one's *field* includes all the external and internal elements and conditions affecting him. Lewin accepted the gestalt psychologists' concept of learning as organization or reorganization, but he contributed further to motivation, personality, and social psychology, particularly the behavior of groups. Some of his concepts are cited later in this chapter.

Other theorists who absorbed much of gestalt psychology have made purpose or goal striving a central factor in behavior. Edward C. Tolman (1886–1959) was the most important of these. For Tolman, learning was not a matter of connecting stimuli with responses but of connecting significance or meaning with stimulus patterns which he called *signs* or *sign-gestalts*. Through learning, the signs of our physical, social, and educational environments come to tell us what will happen if we act in this way, that way, or some other way. This occurs, according to Tolman, by contiguity or by what we do and notice.

We don't have to be motivated to learn in this way, but our purposes always determine what we do. Having learned, we can anticipate the results of different actions—that is, think about the possibilities—and choose a course that will gain us our goal. Thus, you have probably learned what may be found in each store of the neighborhood. Today, your motives will determine which, if any, you enter. You don't go into a restaurant and place an order unless you are hungry, even though you know you would be fed.

Readiness in Cognitive Theory

In cognitive theory one's present knowledge is truly the foundation of his further learning. What we have learned up to now is assumed to exist in our memory as *traces*, or, if you prefer, ideas. When the traces relating to a particular field of knowledge or experience are clear and will organized, they provide the framework to which new ideas may be related and attached. As we might expect, the ideal "cognitive structure" for each field is one in which the main ideas or broad inclusive concepts stand out clearly and are well supported by lesser generalizations as well as specific details. Learning something new is then a matter of seeing where it "fits in." The lack of relevant "cognitive structures" may mean that new facts and concepts can be related to nothing in the learner's experience and must be learned by rote. An isolated fact about the practices of an obscure religious sect, for example, has little meaning for us unless we have previous knowledge of the main tenets of the religion and how these are related to our own. The adequacy of initial learning obviously determines the quality of our "intellectual scaffolding" in each area.

A further and more distinctive cognitive emphasis in readiness is that of adapting materials and methods to the learner's way of viewing the world and learning from it. Although there are no definitive guidelines to tell us how learners of a given age or degree of experience differ in this respect, some useful observations have been made.

The very young and the inexperienced in any area are usually better able to perceive essential relations when they are given some opportunity to work with concrete materials. It is as if they had a limited capacity to manipulate, examine, and draw conclusions about objects or events not directly before them. Introductory number concepts—the generality of *four*, for example—are easily grasped by first-graders when they can actually see, count, and match: four pencils, four erasers, four cups, an so on. Students may understand the general rule that $a + (b + c) = (a + b) + c$ in terms of the operations of combining cups of sand or water, when they would find the symbols completely meaningless.

At a later level of intellectual development students are partially freed from their dependence on materials actually before them. Before this they might have understood problems of weight and balance when actually working with a balance beam or its more humble equivalent, the seesaw; but now they can reason about a remembered seesaw or understand a crude sketch in which the plank is represented by a single line and children by rectangles. At this level students are still very dependent on their own personal background of experiences, however, even though they can work with memory traces as well as actual materials.

Still further development and/or experience enables students to deal directly with symbols without immediate or recalled physical props. Mathematics or science students who are ready to learn in this way should not find it difficult to make the transition from understanding that 4 pounds at 4 feet from the fulcrum of a balance beam equals (will balance) 8 pounds at 2 feet to the application of the formula $f = wd$ (force equals weight times distance) to lever problems and mechanical advantage.

Adjusting instruction to students' present ways of thinking and working is the surest way to hasten and ease their further development. Attempts to bypass the less abstract or symbolic stages of learning when your students approach new tasks at these levels are unwise, for memorization without understanding may result.

DEVELOPING AND USING MOTIVATION

Motivation and purpose are much the same in the cognitive view of learning. The learner's goal is the end result he anticipates and desires. Because this goal, rather than a learned pattern of responses, controls the learner, his behavior can be flexible and intelligent. If he sees a shorter route to his goal, for example, he takes it. He is not bound to a longer or more arduous path simply because he has taken it before. If goals direct and regulate the learner's behavior, the teacher's most important responsibility may be to help the learner find worthwhile purposes (motives) and establish clear, realistic goals.

Cognitive theorists recognize and use, but are inclined to regret, the prominence of social and achievement motives in school learning. They believe students' interest in learning for its own sake suffers as a result. Ausubel is one of those who attributes this state of affairs to the emphasis of our culture on achievement and anxiety reduction:[1]

> If the desire to learn and understand is almost invariably exercised in the context of competing for grades, obtaining degrees, preparing for a vocation, striving for advancement, and reducing the fear of academic and occupational failure, there is little reason for believing that much of it survives as a goal in its own right.

Utilitarian motives may satisfy the teacher if he too is thoroughly acculturated. If not, there is some promise in the wider use of the generalization to which we turn now.

Cognitive motives are aroused and sustained by slight to moderate variations on the familiar: the puzzling and unexpected but not the difficult or incredible. Pribram (1964) describes a related situation in which a tone is repeated at irregular intervals. At first, a listener will react to the tone by turning. Physiological tests show that he is attending to it. After five to ten minutes the tests suggest that he has lost interest, but any change in the length, tone, or intensity of the sound will again alert him. The listener will adapt to change also, however, if it is too frequent. Pribram suggests that a slight change will restore attention but continual change will destroy it. The good teacher, he states, will first uncover the boundaries of what is familiar to his students. Probing questions will help. He then introduces elements of novelty, but not too many or too rapidly and always with a sharp eye for signs of alertness. In other words he evaluates the "orienting responses" of his students and paces his presentation to maintain their interest and attention.

---

[1] David P. Ausubel, *The Psychology of Meaningful Verbal Learning* (New York: Grune & Stratton, 1963), p. 227. Reprinted by permission of author and publisher.

The teacher's management of conflicting motives may be an important factor in students' success. Lewin recognized three types of such conflicts. Everyone knows the relatively harmless *approach-approach conflict*, in which we have to choose between two attractive alternatives. A teacher may create *avoidance-avoidance conflicts* when he attempts to force students to unpleasant or boring tasks with threats or punishment. They must then choose between "evils." There may be indecision, anxiety, and resentment. Some students may resort to daydreaming or truancy in their attempts to escape. Teachers often meet the resistance of students with greater threats and harder tasks, which only make the conflict more serious. A more effective approach, according to Lewin, is to assign more reasonable tasks and make the consequences of failure less severe, thus reducing one of the "horns" of their dilemma.

Approach-avoidance conflicts arise in situations where the same object, condition, or activity both attracts and threatens. There are many common examples. The student who has difficulty with his arithmetic wants to ask for help but is afraid the teacher may think him a weak student. Another desires to attempt an original project but isn't sure how the teacher will mark it. Another wants to work for better marks but knows his friends will taunt him if he does. These are among the most persistent conflicts because, when one tries to "leave the field," the attractive aspect of it keeps pulling him back.

The teacher who is aware of existing approach-avoidance conflicts may find ways of reducing the threat of one alternative or increasing the attractiveness of the other. There may be a third alternative the student has not considered. Obviously, the best advice is to avoid creating conditions that may lead to conflicts for students.

GUIDING EXPLORATION AND ACTION

One who is trying to trace a figure, hit a target, steer a car, type a letter, or solve an equation probably does not act in a chance fashion, no matter how clumsy or inept he appears to be. He may be trying to make his behavior fit a perceptual or cognitive pattern. The teacher's attempts to help the learner to understand any of the tasks center on his efforts to expose relationships that permit a sensible hypothesis or effort. A variety of techniques are useful. The omission of less important details often helps in the early stages of skill or informational learning. Overviews, outlines, analogies, and simple diagrams serve a similar purpose and may provide a framework for the organization of subordinate ideas later.

These procedures stress the perception of relations in whole common-sense situations. The "whole is greater than the sum of its parts" because of the importance of patterns and relationships. The whole-first approach is one of the key differences between cognitive and association psychologies. The association theorists are accused of analyzing common-sense situations and acts into meaningless segments. Their formula is said to be "Teach A, drill A; teach B, drill B; drill A and B together."[2]

The practice of beginning with meaningful wholes is well established in educational practice. In the teaching of reading, for example, we begin with thoughts, interesting and understandable to the learner, rather than with a,b,c's or letter-combination charts. The details of word meaning and structure emerge more slowly. When children do have the insights that give these parts meaning, they are powerful tools, of course, in an attack on new and more difficult verbal wholes. Quite similar directions are evident in the teaching of arithmetic, writing, swimming, and in nearly every type of formal and informal instruction.

Some psychologists identified with the theories under discussion have endorsed independent learner discovery and the withholding of direct teacher guidance. Others have different views, however, and would use fully as much guidance as S-R enthusiasts. The real issue is not *how much* guidance but *what kind* of guidance. The S-R approaches use *any and all* available methods or means to prompt and reinforce a response in the "right direction." The prompts may be quite unrelated to factors that actually determine the response. Any reinforcement that works is all right too. Gradually cues are withdrawn and irrelevant responses are discouraged by nonreinforcement in a manner and at a rate carefully chosen to prevent errors.

---

[2] T. R. McConnell, "Reconciliation of Learning Theories," in N. B. Henry (ed.), *Psychology of Learning*, 41st Yearbook, Part II (Chicago: National Society for the Study of Education, 1942), p. 258.

There are several differences in the cognitive approach. From the beginning an attempt is made to focus attention on elements and relationships that determine the correct response. To do this it may be desirable to strip away some details temporarily or to find some means of enhancing the distinctiveness of important cues. Errors, or the clear expectation of errors if certain responses are made, are considered essential to understanding and insight. Once there is a clear realization of the alternatives and where they lead, learning is essentially complete. Opportunities to put new learning to the test by acting on expectations are important, of course.

To be most useful teacher guidance must match the student's level of thought or ways of working. If a student has not advanced beyond the level of thinking in terms of concrete examples, information presented symbolically will not help him. This point has been discussed more fully in relation to readiness.

The teacher can often find ways to provide information or organization that will enable learners to find purpose, order, or familiar elements in seemingly arbitrary associations and skills. The tendency of learners to organize such tasks has often been noted. It is rare that we try to memorize even a grocery list or a class roster without imposing some kind of order. We learn the number of days in each month with the jingle which starts, "Thirty days hath September, April, June, and November."

The formation of concepts and principles may be regarded as the reorganization or restructuring of experience. The teacher's role is one of using all appropriate means to emphasize or clarify the critical features of both new and old experience. After he identifies the adequacy of the learner's initial concept of animal, for example, new examples of animals or "nonanimals" lead the learner to reconstruct his former concept. Similarly, each successful or unsuccessful application of a principle helps to develop a fuller understanding of it.

MANAGING THE CONSEQUENCES

A student's first attempts to solve a new problem are often based on a rather vague or general impression of the whole. The teacher's comments, or other consequences of this first effort, may help him structure the situation so that his further tries "make more sense." The informative value of consequences is relatively more important in the cognitive scheme of learning than is the strengthening of response tendencies or reinforcement. Rewards may attract and hold the learner's attention, however, so that he studies a problem more carefully, hence, comes to know it better. There are occasions also when the distinction between information and reinforcement becomes blurred. If our goal remains the same, and if our insight into a problem doesn't change, we certainly do tend to repeat a successful act or drop an unsuccessful one. The "ifs" are important here. We repeat an act because it still seems to serve our purpose, not merely because it was previously followed by satisfaction. As a matter of fact, men learn and use a punished response if it suits their purpose. In commenting on evidence of this Dashiell (1938) has asked if the law of effect might not refer to a "right-path-to-objective effect."

The effect of consequences always depends on their meaning to the learner. The most extensive studies of how learners interpret consequences are those relating to Lewin's concept of the *level of aspiration*. This is the level of performance that a learner expects to reach on a familiar task. When this task is at all important to him, his level of aspiration defines success or failure for him. Success leads to higher but realistic aspirations, and failure generally leads to lower aspirations but occasionally to unrealistically high or low ones. Teachers and others in authority should help students set realistic goals so that success comes with reasonable frequency. They should neither "hitch their wagon to a star" nor be content with working well below their potential.

Students for whom social motives are more important than achievement are especially prone to settle for "average." Seagoe[3] describes one incident in which an able student of only average achievement was advanced a full grade. He then met the average of the higher grade almost as easily as he did that of the lower. For most students, however, the "successful" level of achievement for tomorrow should be set just a little above the performance of today. Small steps are surest when we attempt to build self-confidence.

PREVENTING FORGETTING

Cognitive emphases on learning with understanding and insight are expected to improve retention. The fundamental reason is that these processes involve the use of organizing principles and other main ideas that are more resistant to forgetting than specific details. In this section we will inquire further into (1) how forgetting is explained, and (2) how retention of details, as well as general relationships, may be improved.

The most common cognitive explanations of forgetting assume the persistence of traces of experiences. Ideas or information previously acquired that can again be called in to figure against the ground formed by the total residue of the past are said to be "recalled." The memory traces are said to interact continually, and inadequately learned material tends to merge with or be replaced by traces of similar material more clearly and firmly established. The recommendations of Chapter 1 for insuring the continued independence of some learning products are relevant here.

We previously stressed the importance of organization in memory traces in relation to readiness. Gestalt psychologists find a tendency toward regularity and completeness or "good form" in memory as well as perceptual patterns. As a consequence they believe that the "loose ends" of learning—that is, those details that do not find a place within larger established memory patterns—will fade rather rapidly. In accordance with the whole to part emphasis within cognitive theory, we hope to forestall this by identifying and teaching the main ideas and general relationships of a new area of study in advance of the details. Thus, we "custom build" our cognitive structures.

---

[3] *A Teacher's Guide to the Learning Process*, rev. ed. (Dubuque: Wm. C. Brown Co., 1961), p. 47.

Comparative "advance organizers" are useful when new materials can be systematically related to previous knowledge. Ausubel and Youssef (1963), for example, gave students a preliminary paragraph that pointed out the similarities and differences between Christianity and Buddhism two days before the study of details about the Buddhist doctrine. Other groups studying Buddhism were not given this introductory paragraph. As predicted, the data showed that the retention of facts about Buddhism was improved by both (1) a good background of related information on Christianity and (2) the initial use of the Christianity-Buddhism organizers.

More generally, the best advice for the improvement of retention is to organize and present learning materials so that the general ideas and relationships are well learned. Essential also is planned review or, better yet, reuse in new contexts and in new operations that have been chosen to keep pace with students' intellectual development.

ENCOURAGING TRANSFER

Transfer of learning to a variety of other situations is expected by cognitive theorists if certain conditions are present. The possibilities exist in generally useful patterns and relationships. The most important conditions are those that facilitate the acquisition of organized knowledge. All that we have suggested in the preceding several sections has been geared to this end.

Other important conditions of transfer in cognitive theories are reflected in their consistent emphasis on understanding and motivation. The learner must realize that opportunities for the future use of his knowledge exist, and he must want to find or recognize these to take advantage of them. Several things that teachers can do have been suggested in the general statements of Chapter 1. Teachers can point out the possibilities for transfer of knowledge, skills, and ideas to situations important to the learner. They can provide opportunities for students to recognize and practice the use of prior learning in a variety of situations.

EVALUATION AND RELATED DEVELOPMENTS

For more than thirty years, cognitive concepts have been challenging conventional education and conventional psychology. The language of perceptions, beliefs, and purposes "makes sense" to educators. On the verbal level, at least, they have welcomed the corrective influence of the cognitive emphases and have given increased attention to the concepts presented in this chapter.

American psychologists have been more reluctant to accept cognitive ideas. The cognitive claims are said to be untested and untestable. An experimentally minded S-R psychologist cannot imagine a more serious charge. In his opinion it must follow that cognitive concepts have little or nothing to offer education. Such a completely negative appraisal does not seem warranted, however. Although there are no cognitive principles as directive as those for the contiguity of stimuli and response or the immediacy of reinforcement, there have been many suggestions as to aspects of the learning process that are important to consider when problems arise in the classroom. Considerations such as (1) the structure of knowledge in a discipline and (2) materials and methods to match the intellectual level of the learner have attracted widespread attention as a result of their use in several current curriculum-revision projects.

Another point should be made. The references to the untestability of cognitive concepts apparently refer to those that remain after a substantial number have been explained in S-R terms (Chapter 3). There is something of an *approach-approach* conflict here for S-R psychologists. If cognitive concepts are found to be correct, when recast in S-R terms, the superiority of the S-R treatment is suggested. On the other hand, if cognitive concepts are discredited, S-R theory is right again.

The future prospects of cognitive theories within psychology itself are not bright. A more analytical approach appears to offer greater advantages in scientific research and theory building; nevertheless, the natural mode of description and the seemingly self-evident validity of some cognitive propositions will continue to appeal to teachers.

5

Relating Theory and Practice

In the preceding chapters we have considered major psychological theories in relation to several elements of the learning process. Now we are ready to examine some of the ways teaching practices would be affected by attempts to apply or test the implications of these theories. The examples illustrate those theoretical emphases that will have the most important effect on teachers' decisions. Programmed approaches to instruction are uniquely useful here for they are based directly on learning theory. The other major chapter divisions, "The Teacher's Presentation" and "Student Activities," are convenient foci for the application of theory to more conventional instructional methods.

TEACHING MACHINES AND PROGRAMMED INSTRUCTION

The simplest of the many "teaching machines" now available is little more than a small box with a window that exposes a question and a space for the student to answer. The student reads the question, writes his answer, and uses a lever to advance the machine to a word or phrase that shows him the intended answer. At the same time a second question is exposed. He continues as rapidly as he wishes; he sets his own pace.

Textbooks in which a student completes a question on one page and then checks his answer on another page are even more popular than teaching machines. Such materials, called either "programmed" or "programed" texts, are being prepared commercially for practically every subject and at every level from the nursery to the graduate school.

The *linear* program for text or machine consists essentially of a carefully prepared sequence of curriculum material broken down into very small units or tasks that lead the student in a very logical way to the behavior desired by the writer of the program. The accompanying excerpt from a mathematical program is an example of a linear program.[1] Everyone completing such a program answers the same sequence of questions. There is but one route through.

1. The numbers we use to count with are called "counting numbers" or "natural numbers." 0, 1, 2, 3, etc. are natural numbers. $\frac{1}{2}$ is not a natural number. Is $\frac{3}{4}$ a natural number? ______ *(Yes or no?)*
2. 0, 1, and 2 are natural numbers. 3, 4, 71, and 10,001 are also ______ numbers.
3. 0 is a ______ number.
4. Which of the following is not a natural number? ______
   $0,\ 12,\ 627,\ 2 + 3,\ \frac{7}{8},\ 5 - 1$
5. Which of the following is a natural number? ______
   $\frac{3}{2},\ 10.2,\ 4\frac{1}{4},\ 8001,\ \frac{1001}{4278}$

Branching programs are available also. In these a student's answers to a question are used to direct him to repeat or skip part of the sequence or to go to a new part of the program. The learning task is presented as a problem, a figure, a paragraph of explanation, or some other conventional form. A question with several possible answers follows. The student checks his answer. If his choice is correct, he is directed to the next task. Some related information may be given also to help him understand why his answer is right. If his answer is wrong, he is informed of the fact and directed to a supplementary series of tasks or given an explanation of why he was wrong. Then, he returns to the question he missed.

The elements of learning that we have been using are very clear in programmed learning. The readiness of the student for the next question or *frame* is assured by his answering the last, and the appropriateness of the program as a whole is determined by extensive tryouts. The learner's immediate goal is the answer to the next question. A well-written program may arouse his curiosity or desire to know, or he may just work for the satisfaction of getting answers right. Of course, the mildly aversive motivations of any school situation are present also. The teacher may always remind him that he is falling behind or that there will be questions like these on the test.

---

[1] Reprinted by permission from *Modern Mathematics: A Programed Textbook* by Lewis D. Eigen, Jerome D. Kaplan and Ruth Emerson. © 1961, Science Research Associates, Inc.

A high degree of guidance is employed in a linear program so that in each frame the student is led, if not directed, to the right answer. The hints or prompts he receives initially are withdrawn as he proceeds through the program, but so slowly that he scarcely misses them and seldom makes an error. The consequences of his responses inform the student and may reinforce him also.

As we have seen, the branching program involves a different concept of guidance and errors. Explanations depend on the mistakes the student makes, and a mistake is regarded as an occasion for further teaching that may add to a student's understanding. The student's ultimate success on every item in the program is assured, however.

At present, programmed techniques are limited to teaching the recognition, recall, and use of facts, concepts, principles, procedures, and some skills. Although a number of authors are optimistic about possibilities for the future, there are no dependable programs to teach good writing, logical thinking, problem solving, group participation, and other more complex educational objectives. The use of programmed texts and teaching machines for some aspects of his work may enable the teacher to devote more time to the achievement of those educational objectives that still require the "personal touch."

FOR CONTIGUITY

Linear programs like that of the excerpt are designed to implement the first principle of contiguity—that is, get the learner to give the right response in the right context. For the same reason, programs that give much guidance—that is, many cues and clues to the correct response in each frame—are preferred. As a matter of fact, some experimental programs give the student the answer before he is asked to choose or supply it. A teacher may wish to do the same in other programs by letting students read the intended answers before writing their own. Such guidance should be withdrawn gradually, however, so the student finally gives the answer, states the principle, or solves the problem as it would normally appear and without extra hints.

Because students are believed to learn only what they do, an actual response of writing or saying the answer should be required. Because the last response a student makes to a situation is the one he is likely to associate with it, a student should not quit without correcting his errors. Unfortunately, some teaching machines do not allow missed frames to be repeated. Unless students make very few errors on a program, some provision should be made for additional practice on missed items. In general also, the more often each important response is repeated the better. If the program we select does not provide enough practice or a wide enough variety of practice situations, supplementary drills should be provided.

Programmed learning should be as pleasant as possible, for attitudes toward the subject matter and toward this method of learning are conditioned. Programs of appropriate difficulty must be chosen: easy enough to give the student confidence but not so easy or repetitious that they bore him. If the presentation can be entertaining as well as educational, so much the better.

FOR REINFORCEMENT

Reinforcement programs are like those that follow contiguity principles with one important difference: The student is never given the full answer *before* he responds, for the purpose of giving it to him is to reward him immediately *after* he does. The reinforcement of finding answers correct time after time is believed essential for continued motivation as well as learning.

Reinforcement theorists are somewhat divided on the question of program difficulty and errors. The most popular approach, that of B. F. Skinner, seeks to eliminate errors completely and thus make the reward of being right a certainty. Other psychologists believe such a certain state of affairs doesn't provoke either anxiety or curiosity in students. They recommend programs that are difficult enough to make the learner uncertain and somewhat anxious. Then, the reduction of anxiety by success can be rewarding. Learning suffers, however, if students fail repeatedly. Some newer branching programs attempt to keep the difficulty at an optimum level by having students go ahead more rapidly when they make few errors and by prompting them more when they make too many.

FOR COGNITIVE LEARNING

Branching programs with large task units, multiple-choice questions, and explanations of alternative answers have considerable promise for cognitive learning. Large task units make it easier to present natural units of material or describe realistic problems of some complexity. An initial overview of the structure and organization of a task can be included to give students greater perspective with respect to subtasks or help them relate new ideas to familiar ones and to important larger goals.

The multiple-choice items are checks for possible difficulties of interpretation or insight. When any such difficulty is revealed, the student is given supplementary instruction to clarify his understanding. In review or application tasks this diagnostic feature leads to efficiency, for each student practices on what he finds most difficult.

Another possibility for future development is the *adjunct program*. Complex and structured material can be presented initially by conventional means—lectures, chapters in books, field trips, experiments, and so on. Such presentations would take the place of the first step in programs like that described in the preceding paragraph. Diagnostic items would then be used to correct and clarify concepts before further progress is attempted. The purpose of such supplementary "programming" would be to increase the value of the many techniques we now use.

THE TEACHER'S PRESENTATION

We can envision many variations in teacher presentations, some using a variety of aids, but the teacher nearly always "shows" or "tells." The term "lecture" is sometimes an appropriate one; but classroom presentations are not very formal, and the teacher usually welcomes occasional questions by students or punctuates his presentation with questions to them. Brief teacher presentations are often linked with other techniques in a larger unit of instruction.

Although teacher presentations can provide motivation, guidance, or evaluation for other learning activities, the criticisms of teachers' presentations usually are directed at their use for transmitting or clarifying information, as though the teacher were an animated text. How may this familiar form of teacher presentation be made more compatible with the emphases of each theory?

FOR CONTIGUITY

The weakness of teacher presentation for this approach is that the student may not do what he is to learn. To put it another way, to improve contiguity learning a teacher must find ways to insure that students respond correctly to important cues when they are presented.

One common practice, which might be used even more widely, is that of interrupting a talk with requests for student responses. A teacher may write a word on the board and tell one student or all to say it aloud. If only one student responds aloud, it is assumed that the others will respond silently. Another teacher points to a map, names a city, and asks students to say the name or write it in their notebooks. In still another class a book is held aloft and the Spanish name is said, first by the teacher or an able student, then by others. Later students are expected to respond correctly to the sight of the word, the place on the map, or the book without an assist from the teacher. Longer responses, such as statements of principles, summaries of data, or the steps of solving mathematical problems, may be prompted in the same manner.

The teacher who attempts to schedule his informal prompting of students more systematically finds that his lectures begin to resemble an orally administered teaching program such as that suggested by Carpenter and Haddan.[2] In essence their plan is to have the speaker present information in a series of brief segments, each only a few minutes long. After each segment, students are to be asked to complete sentences or answer related questions. From the contiguity point of view students could be given the answers verbatim, at least when new material is being introduced. Another possibility would be to give each student a duplicated list of questions that he is to answer during the lecture. Under such a plan a lecturer would merely pause every few minutes to see if his pace is appropriate and to check the need for a review of previous points.

---

[2] *Systematic Application of Psychology to Education* (New York: Macmillan, 1964), pp. 145–162.

The teacher is obviously at some disadvantage with respect to the machine in administering a program. Try as he may, the teacher's materials will seldom be prepared with the rigorous attention to detail and sequence that characterizes the commercial program. The pacing certainly cannot be highly individualized. The teacher does have the great advantage, however, of being able to work toward objectives of his own choosing. The standardized program suffers from the same limitation as the standardized test—that is, it seldom quite suits the local course of study.

If we wish to be somewhat more speculative, contiguity theory suggests a further role for the teacher, one that future investigators may find crucial. The teacher may be an agent for increasing students' pleasure in course-related concepts and activities. While presenting his material he may use his personal charm and wit, praise, and assurances to reduce students' anxiety and arouse their positive feelings. According to the classical conditioning formula the material itself will then become a source of pleasure.

Having a happy class is not enough, of course. Regaling them with stories or giving all "A's" is not enough. Students must be stimulated by significant aspects of the subject-matter (conditioned stimuli) at the same time the teacher's devices (unconditioned stimuli) make them "feel good" (emotional responses). Furthermore, the teacher's approach to his subject is still systematic and analytical. His aim is to attach positive emotional reactions to as many specific elements of the course as possible in the time allotted to him. He judges his success by students' continued interest and activity. Do they take notes and review them? Do they wish further discussion of important ideas? Do they seek related readings? Later, do they take other courses or "major" in the same area?

In each additional experience the students should find pleasure in the facts, opinions, and conclusions, perhaps the actual words of the course. Whenever they express an idea, use a concept, or take a stand on an issue, agreeing with the course should tend to make them "feel better."

The language of reinforcement rather than that of conditioning might well be used to present these interesting possibilities for emotional training. The concepts of secondary drive and reinforcers suggest a way words and other course elements can come to motivate students later. Contiguity would still be an essential factor, however, in explaining how course elements acquire their influence initially.

FOR REINFORCEMENT

The suggestions for a contiguity approach can be endorsed here, *if*, and this is important, student responses are consistently followed by reinforcement. The more traditional descriptions of reinforcement learning suggest that right responses are selected and confirmed. We think, for example, of a teacher pointing to a city on the map of South America and inviting students to name it before he says, "That's right, it's Rio de Janeiro." In the contiguity approach, you will recall, the teacher would give the city's name, then have students repeat it. Even if errors are few, the confirmation of hearing the answer again from the teacher is said to result in greater learning. The teacher should give a full statement of the desired answer and supplement this with other reinforcements, perhaps praise or smiles, when he knows these work well with particular students.

The typical teacher's presentation assumes a great deal about both the responses of his students and their reaction to reinforcement. Ideally, he gets students to imitate his thought processes and paces his presentation so that they push ahead of him to answers or tentative conclusions. Questions aimed at one of the class or to the class at large may help. Then, he steps out in front again, as it were, with information that reinforces the responses he hopes they have made. This procedure can work well, but we cannot even be sure any substantial number of the class respond, unless we provide for them to do so overtly.

Short presentation segments may be used in a "programmed lecture," such as that described for a contiguity approach. The reinforcement practice might be to have all students answer oral questions or written ones duplicated in advance. The teacher talks or shows, then the students answer, then the teacher gives the intended answers as reinforcement.

In this or other types of presentation the teacher will wish to keep a close check on the difficulty of his material. Whenever too many errors are observed in students' comments or their responses to his probes, or if doubt is suggested by their perplexed expressions, he should slow up and give more details. Conversely, when no errors are evident and students begin to appear bored and disinterested, he might speed up and give fewer explanations and illustrations.

The reinforcement-minded teacher who uses presentation methods will be intrigued with the opportunity to experiment with sequences designed to develop learning sets (Chapter 3). Repeated direct or vicarious reinforcements for responses to a series of problems involving the same principle may be a promising method of developing students' ability to cope with other problems involving this principle.

FOR COGNITIVE LEARNING

The teacher who is guided by cognitive theories uses presentation methods to display the natural structure of materials or activities. The teacher's own ability to find order and lawfulness in what he teaches is the first requirement. Then, he must seek words and examples that will make the relations he has found important to the student and crystal clear. There are only a few guidelines to follow in doing this. Generally speaking, cognitive psychology offers the teacher a challenge rather than prescriptive statements. Those who accept the invitation need a high degree of both scholarship and professional judgment.

The contrast between cognitive and association emphases is often sharpest when association principles seem an obvious choice. Teaching the multiplication combinations involving nines is one example of this type. An association-minded teacher might see this as a matter of forming and strengthening a separate connection for each combination of the nines table. Let's suppose instead that the teacher asks himself if there is any opportunity here to develop a greater understanding of relations among numbers that may make this and future tasks easier and more interesting. As it happens, there is.

The teacher decides to use a brief lecture-demonstration. He begins by writing the list of combinations from 9×1 to 9×10 and from 10×1 to 10×10 on the chalkboard. He asks one or two students for the answers to previously learned combinations and accepts contributions from several volunteers. He also asks for the products of several combinations not yet studied in order to stimulate greater interest in the "easy way" he is about to show them.

A comparison of the nines table with the tens tables and the use of a row of numbers from 1 to 100 enable him to bring out the following—not in these words, of course: (1) The left digits of the products of both the nines and tens tables go up by one each time the multiplier increases by one, that is, $9 \times 1 = \mathit{09}$, $9 \times 2 = \mathit{18}$, $9 \times 3 = \mathit{27}$, and so on; and $10 \times 1 = \mathit{10}$, $10 \times 2 = \mathit{20}$, $3 \times 10 = \mathit{30}$, and so on. (2) The left digit of a tens product is always equal to the multiplier, that is, $10 \times \mathit{1} = \mathit{10}$, $10 \times \mathit{2} = \mathit{20}$, $10 \times \mathit{3} = \mathit{30}$, and so on; but the left digit of the nines "lags behind" and is always one less, that is, $9 \times \mathit{1} = \mathit{09}$, $9 \times \mathit{2} = \mathit{18}$, $9 \times \mathit{3} = \mathit{27}$, etc. (3) Each time the *left* digit of the nines products goes *up* by one, the *right* digit goes *down* by one, so that their *sum remains at nine*—09, 18, 27, 36, 45, 54, 63, 72, 81, 90.

All of the above points are especially clear to students when they are shown on an abacus, for each time a nine is to be added a ten marker is moved over and a one marker is brought back. Few students, even those who cannot put it into words, will fail to see that all they have to do to multiply nine by any number is to put down one less than the number and follow this with nine minus the first number (or ten minus the multiplier). For example, 9×8 is 7 (one less than the multiplier) followed by 2 $(9 - 7)$ or 72. For homework, students might be given the task of extending the procedure to combinations above 9×10.

In many schools children would know one as the complement of nine and may easily be led to relate finding nines products, computing on an abacus and computing with complements. The use of complements is not limited to addition or the nines but has many applications in mathematics. A number of "high-speed" methods using complements would interest some students.

Our analogy with programmed learning is still useful, and we may think of this teacher's presentation as the information segment of a program with large task units. The oral or written questions that usually follow are an informal "adjunct program" to confirm understanding and to show where "branching" for review or further explanation is needed.

STUDENT ACTIVITIES

When the teacher of a class is not presenting material, he is, more often than not, trying to elicit or guide student activity. An observer may recognize the familiar "oral quiz" or recitation over an assignment, the relatively free verbal interchange of the discussion, or something neither one nor the other but a little of both. He may find different individuals or small groups proceeding rather independently with only an occasional assist from the teacher and be told that they are working on projects or "a problem." He probably knows the project as a task that students complete somewhat independently and may think of a problem as either the same thing or as something entirely new.

Actually, learning experiences that extend beyond a single class period are often planned within the general framework of a problem. This approach is not so much a new method as a different emphasis in the use of familiar methods. In this approach, which resembles scientific research in some ways, the teacher assumes the role of a guide or co-investigator in (1) selecting and defining interesting and worthwhile problems, (2) formulating and evaluating proposed solutions or hypotheses, (3) planning and completing study or experimentation pertaining to proposed solutions, and (4) applying and using the conclusions.

As our observer noted, the possible combinations of activities in a problem-solving approach are many. A discussion is well adapted to selecting and defining problems and the planning stages of other steps, as well as for reaching conclusions when the data have been collected. The teacher may present some of the data needed by students or explain some of their difficulties. More data are gathered in assignments or projects. The application of conclusions may lead to still further projects.

Some of the steps of problem solving parallel the elements of learning as we have presented them. This is one of the reasons why a problem-solving organization is often advised in methods courses for teachers. When the learner accepts a class problem as one that is important to him, the correspondence is particularly close. It is well to remember, however, that learning does not require this classroom emphasis. A motivated student may find a goal and attain it in a lecture or in reading a text. He learns from question to question in programmed texts, as well as by completing the several steps in the development and solution of a formal problem.

FOR CONTIGUITY

An active response by the learner is the first requirement for learning by association. Increased student participation during teacher presentations was suggested; but student participation can be more continuous when the teacher only reviews, in a sense, material previously covered in less controlled situations, such as outside reading. Associations formed under conditions where the teacher cannot control both stimuli and response would be considered somewhat haphazard without such a review.

The stage is set for student participation in controlled contiguity learning when the students have prepared and the teacher has a series of questions with the expected answers before him:

T: "What are the three purposes for which nonfiction is written?"
S1: "To entertain. To inform other people."

The teacher writes these ideas on the board, and there is silence in the room.

T: "You have two of the purposes of nonfiction. What is the third? Janice? Bill?"
S1: "The book said to give ideas."

Teacher writes "ideas" on the board.

T: "What do we mean 'to give ideas'?"
S2: "Well, to tell other people what you think."

T: "Is that all?"
S3: (Glancing at his open book) "To convince others that what you think is right."

T: "Now you have it. The next question is . . ."

At some point in this fairly typical recitation the teacher may have a student state the question again and read the answers aloud from the board, while other students repeat them silently.

Later, he may ask the students to copy the list in their notebook, thus providing still another repetition.

The spirit of contiguity learning carries over into the assignments of a teacher. Assignments are often considered preparation for conditioning in class, but the right kind of an assignment provides additional opportunity to form associations. Consider the homework instructions of a German teacher, for example: "Copy each of the next 50 vocabulary words beginning with 'klein' on the left of a small card. Put the English equivalent on the right of the same card. To study, look first at 'klein' while covering 'little,' then look at 'little.' Do the same with each word. After a number of repetitions of this kind you will have learned them all." He might have said that when they can say "little" to the stimulus "klein" without looking they will be conditioned. Other lists, formulas, speeches, or poems may be learned in the same way. It is laborious to learn an entire poem a word or phrase at a time with each word or phrase serving as a stimulus for the next, but that is the way of learning by association.

Lessons may be built of such deliberately planned associations. The combined associations of lessons are the outcomes of units, and they in turn form blocks of instruction or courses. There is provision, of course, for a variety of responses. Statements of specific fact, illustrations, comparisons, conventions, trends, cause-and-effect relations, and evaluations are a few of the verbal associations that may be systematically conditioned.

Contiguity partisans are not indifferent to the possibilities for more complex learning during student participation. They say that students may be conditioned to enjoy and seek course-related activities of all kinds. Our speculations on the conditioning of emotional responses to the teacher's presentation have suggested some of the possibilities. In general, students are believed to learn whatever they are led to do. If they are led to trace and develop a thought, question it, and relate it to other thoughts, this is what they learn. The example of the teacher or other students may be the way to get them to do and learn such things. However, how will they tell the good examples from the poor? Obviously by the effect on the teacher and other students. The teacher will not wish to leave this effect to chance, of course, so he will try to act in such as way as to rather consistently differentiate the better from the poorer actions of students.

At this point we are so close to the reinforcement explanation that we may simply refer to it. In doing so, we do not say the contiguity explanation is wrong, merely that the reinforcement position is much the same, yet still more helpful.

FOR REINFORCEMENT

A commitment to reinforcement obligates the teacher to arrange satisfying consequences. Other than this his tactics with respect to teaching specific associations are similar to those of teachers who follow contiguity theory. In these associations both the stimuli and the response are well defined and fairly easily shown to the learner.

The most unique contribution of reinforcement is in the encouragement of student responses that the teacher cannot control fully or call forth at will. Our objectives for students with respect to problem-solving skills provide some familiar examples. Consider the process of clarifying a problem. To be more specific, this can be subdivided into (1) effective use of related information, (2) willingness to suspend judgment, (3) thoroughness in exploring the possibilities, (4) identifying the criteria of a good solution, and so on. If such attitudes and skills were to be encouraged during a class discussion of a plan for the study of an assigned topic, what might a teacher do?

We will assume that such a teacher has illustrated the techniques of problem solving and that his students have worked several other problems together. The teacher reviews his knowledge of students' prior experience and present competencies as individuals and as a group. He recalls that they are prone to jump to conclusions and decides that today he will give particular attention to their willingness to suspend judgment. At the same time he will use such opportunities as he has to reinforce other skills and attitudes important in this part of the problem-solving process. He will try also to encourage progress toward several other objectives related to participation in group decisions and to oral communication.

The teacher plans a free discussion, for he does not know exactly what more he can do or say in this particular situation to help students learn to hold back and be less precipitous in their decisions. Although he knows student suggestions and actions relative to the objectives he has chosen will vary in quality, he cannot specify in advance the particular response that should be reinforced. If he stopped to reflect on the matter, he might be encouraged or amused by the fact that psychologists who shape the behavior of rats might also have difficulty in describing exactly what movement their "pupil" should make at any given point in training. This teacher is confident, however, of his ability to recognize the right kind of response, and he will be ready to reinforce it when it occurs. He knows the reactions of students as individuals and will try to choose words and actions that will work best for each. He expects that several students will help him by recognizing and approving several types of appropriate behavior.

Shaping is an apt term for what this teacher plans. We have described this process before (Chapter 3). He will try to reinforce any improvement—that is, any act or suggestion that is better than that typical for individuals of this group up to this time. Of course, today's improvement may be ignored or noted as a step backward next week. His judgment is sometimes faulty also, so that under his tutelage there is some retracing of steps, some learning that must be forgotten later. Even an especially skillful administration of reinforcement does not produce dramatic changes in a single discussion; but to be optimistic he hopes that after today there will be an increase in probability, if not a detectable difference, in some student's willingness to look for more facts, to consider different alternatives, and so on, before urging that they "get started on something."

Any teacher would be more optimistic of his chances for success in shaping problem-solving ability, laboratory skills, effective styles of communication, artistic expression, or other complex behavior if he could work with students individually. The teacher would like to think of his role as that of continuously monitoring the progress of an individual to help and reinforce him. Some of this takes place in school situations but not in the typical class. In group situations we again depend on the somewhat unpredictable results of vicarious learning. When we give a verbal "pat on the back" to the student whose contribution turns the attention of the class to exploring other aspects of the problem more thoroughly, do we increase the probability of similar responses in other students? Can we arrange a response to the suggestion of a slower student that will reinforce him at his level without misleading others who are more advanced? These and other problems contribute to the inefficiency of group procedures for the attainment of a number of important objectives.

The importance of the concept of shaping warrants the inclusion of a further brief example from the classroom. We have chosen one from beginning work on the writing of poetry. This class is making a start with respect to one of the most essential elements of poetic composition and will work on other elements and the consideration of poetical devices and structures later.

The teacher begins dramatically by having students close their eyes and imagine they will never see again. "Think about what single thing you would most like to have in your memory . . ." They spend a few minutes thinking and reporting, and then the teacher reads a short passage in which Helen Keller has expressed the joy and beauty she finds in nature. Miss Keller urges that others use their eyes as if tomorrow they would become blind.

T: "She sort of implies that we are all a little blind, doesn't she? Now take a look at your hand and tell me what you see."

S: "Shape of an M." "Wrinkles." "Knuckles." "Fingernails."

T: "Well, I hope you have one nail to each finger."

S: (Laughing appreciatively) "On someone who uses his hands in his work, you'd see calluses."

T: "That's good observing, but let's restrict this to our own hands."

S: "A tree."

T: "He's speaking poetically, which is good. Someone else?"

The teacher shifts the attention of the class to a green vase and then to "something that will make me see winter changing into spring." The process is slow; but as the teacher continues to comment favorably on responses he likes and to ignore the others, the contributions become more and more specific, detailed, and original.

FOR COGNITIVE LEARNING

Student participation in learning has been given a prominent place in the cognitive teaching strategy also, but not for reasons of association. For S-R purposes responding *is* learning, while from the cognitive view it merely *aids* learning, that is, understanding. A student's action aids understanding when its consequences confirm tentative hypotheses or lead to their revision.

One view of learning is that the learner's activities are always appropriate to the situation as he understands it. Consequently his actions give the teacher evidence of the adequacy of his interpretation. They tell the teacher when further explanation or experience is needed and perhaps what kind as well. Because his objective is increased understanding rather than fixing a response, the teacher is not satisfied with merely indicating adequate and inadequate responses; he will do his best to make it clear *why* a student's action is more or less adequate.

An attempt to implement this view in the contexts of the examples of the preceding section—that is, to clarify a problem or encourage keener observation and poetic expression—would be marked by greater efforts to teach a pattern of generalizations and supporting ideas so that it would be clear where various student suggestions might lead and why some contributions might be considered better or more useful than others. If you reread the examples of shaping in the preceding section carefully, you may now find the process somewhat mechanical and contrived, perhaps even slightly unethical. If this process were much more reliable than it is, we might raise a question about the desirability of molding students to our ends, perhaps without their knowledge or consent (Skinner, 1948).

The value of student responses for diagnosing learning and providing feedback would lead many teachers to plan the learning of the nines table, as described under "The Teacher's Presentation," as a group experience in discovery. Students' attention would be directed to a comparison of the nines and tens tables and to the progression of products in the two tables, but they would be encouraged to supply reasons and rules in their own words: "The 9 × 1 is one less than the 10 × 1 so the nines never can catch up," suggests either incomplete insight or inexact expression. One teacher who did not settle for this response was pleased with, "The left one goes up one each time and the right one goes down one. One more cancels one less so the sum remains the same!"

Understanding is one of two traditional cognitive emphases that has encouraged teachers to organize the curriculum around problems of some duration or substantial units of content. A broader context obviously increases the opportunities for the patterning of ideas. It is equally essential if students are to relate these ideas to goals that appear realistic and worthwhile.

An increased emphasis on students' own goals and larger, more inclusive units of work leads to frequent group discussions in the planning and carrying out of activities, often in the problem-solving pattern. Such discussions differ from those of classes managed by reinforcement principles in that the problems to be clarified are more often ones that students have chosen to implement their own interests in an area of study. Small group or individual work within the broader problem context is encouraged to provide for some diversity of interests and to adapt materials and methods to the intellectual operations (levels) of the students.

CONCLUDING STATEMENT

Without minimizing the importance of verified facts and principles, we have assumed that the teacher's "personal theory" and his efforts to "be consistent" have an even greater effect on his classroom practices. To a degree, theory and fact are complementary; when knowledge is meager, theory assumes a proportionately larger role. This is believed to be the case in much of teaching.

We have urged more attention to psychological explanations in efforts to be consistent educationally. Despite the limitations of these theories, they are the results of systematic explorations of evidence and ideas about learning. Their differing emphases reduce in summary to several general questions that a teacher might ask first in any situation:

Contiguity:	What models or prompts will direct learners' attention and elicit appropriate responses simultaneously?
Reinforcement:	What reinforcers are effective and how can they be administered (scheduled) optimally?
Cognitive:	What organization of materials or activities will lead to an understanding of general ideas and supporting details in relation to important personal goals?

What should the teacher do about diverse theoretical emphases? He would not want to ignore the proven contributions of any theory, obviously, but he may give priority to one view regularly or as difficulties arise in his present practices. Another alternative, of course, is a synthesis of the several explanations, not haphazardly or uncritically, but by assigning a definite educational role to each. The contiguity principle, for example, is definite about arrangements for teaching somewhat arbitrary associations and emotional responses; the cognitive approach is concerned with intellectual tasks that involve complex symbolic behavior in relation to content that may be structured to facilitate understanding and use; and reinforcement concepts may have unique advantages for forming a variety of attitudes and skills with few or inconspicuous cognitive elements.

Finally, there is admittedly insufficient evidence of how well the concepts derived in psychological theory or the laboratory apply in the classroom. The risks of overgeneralization are great; but they may be reduced somewhat if extensions of psychological concepts to teaching are proposed, not as fact, but as hypotheses that merit further tryout in classrooms. This is what we have advised. With this proviso, we suggest that any remaining risk in the use of learning theories is preferable to the alternative hazards of dependence on hunches, uncritical imitation, or habit.

References

Ausubel, D. P. *The Psychology of Meaningful Verbal Learning.* New York: Grune & Stratton, 1963.

——— and Youssef, M. "Role of Discriminability in Meaningful Parallel Learning," *Journal of Educational Psychology,* **54** (1963), pp. 331–336.

Bandura, A. "Social Learning Through Imitation," in M. R. Jones (ed.), *Nebraska Symposium on Motivation.* Lincoln, Nebraska: University of Nebraska Press, 1962, pp. 211–268.

Brueckner, L. J. and G. L. Bond. *The Diagnosis and Treatment of Learning Difficulties.* New York: Appleton-Century-Crofts, 1955.

Carpenter, F., and E. E. Haddan. *Systematic Application of Psychology to Education.* New York: Macmillan, 1964.

Dashiell, J. F. "A Survey and Synthesis of Learning Theories," *Psychological Bulletin,* **32** (1935), pp. 261–275.

——— "Symposium on the Law of Effect," *Psychological Review,* **45** (1938), pp. 191–218.

Guthrie, E. R. "Conditioning: A Theory of Learning in Terms of Stimulus, Response, and Association," in N. B. Henry (ed.), *The Psychology of Learning,* 41st Yearbook, Part II. Chicago: National Society for the Study of Education, 1942, pp. 17–60.

——— *The Psychology of Learning.* New York: Harper, 1935.

——— and G. P. Horton, *Cats in a Puzzle Box.* New York: Rinehart, 1946.

Harlow, H. F. "The Formation of Learning Sets," *Psychological Review,* **56** (1949), pp. 51–65.

Hilgard, E. R. "The Place of Gestalt Psychology and Field Theories in Contemporary Learning Theory," in E. R. Hilgard (ed.), *Theories of Learning and Instruction,* 63rd Yearbook, Part I. Chicago: National Society for the Study of Education, 1964, pp. 54–77.

——— *Theories of Learning.* New York: Appleton-Century-Crofts, 1956.

Jones, M. C. "The Elimination of Children's Fears," *Journal of Experimental Psychology,* **7** (1924), pp. 382–390.

Köhler, W. *The Mentality of Apes,* trans. from 2nd rev. ed. by E. Winter. New York: Harcourt, Brace, 1925. Original German edition, 1917.

Lindgren, H. C. "The Teacher Helps the Learner Interpret His Experiences," in *Learning and the Teacher,* 1959 Yearbook. Washington, D.C.: Association for Supervision and Curriculum Development, 1959, pp. 81–104.

Luchins, A. S. "Mechanization in Problem Solving—The Effect of Einstellung," *Psychological Monographs,* **54** (1942), No. 6.

Lumsdaine, A. A. "Educational Technology, Programmed Learning, and Instructional Science," in E. R. Hilgard (ed.), *Theories of Learning and Instruction,* 63rd Yearbook, Part I. Chicago: National Society for the Study of Education, 1964, pp. 371–401.

McConnell, T. R. "Reconciliation of Learning Theories," in N. B. Henry (ed.), *Psychology of Learning,* 41st Yearbook, Part II. Chicago: National Society for the Study of Education, 1942, pp. 243–286.

Mandler, G. "From Association to Structure," *Psychological Review,* **69** (1962), pp. 415–427.

Miller, N. E., and J. C. Dollard. *Social Learning and Imitation.* New Haven, Conn.: Yale University Press, 1941.

Pribram, K. H. "Neurological Notes on the Art of Education," in E. R. Hilgard (ed.), *Theories of Learning and Instruction,* 63rd Yearbook, Part I. Chicago: National Society for the Study of Education, 1964, pp. 78–110.

Resnick, L. B. "Programmed Instruction and the Teaching of Complex Intellectual Skills: Problems and Prospects," *Harvard Educational Review,* **33** (1963), pp. 439–471.

Seagoe, M. V. *A Teacher's Guide to the Learning Process,* rev. ed. Dubuque: Wm. C. Brown Co., 1961.

Skinner, B. F. "The Experimental Analysis of Behavior," *American Scientist,* **45** (1957), pp. 343–371.

——— "The Science of Learning and the Art of Teaching," *Harvard Educational Review,* **25** (1954), pp. 86–97.

——— *Walden II.* New York: Macmillan, 1948.

Thorndike, E. L. *Educational Psychology, Vol. II, The Psychology of Learning.* New York: Teacher's College, Columbia University, 1913.

——— *Fundamentals of Learning.* New York: Teacher's College, Columbia University, 1932.

Tyler, R. W. "Permanence of Learning," *Journal of Higher Education,* 4 (1933), pp. 203–204.

Watson, J. B. *Behaviorism,* rev. ed. Chicago: University of Chicago Press, 1930.

Wertheimer, M. *Productive Thinking,* rev. ed. New York: Harper, 1959.

Further Reading

Bigge, M. L. *Learning Theories for Teachers*. New York: Harper, 1964.

Bugelski, B. R. *The Psychology of Learning Applied to Teaching*. Indianapolis, Indiana: Bobbs-Merrill, 1964.

Gagné, R. M. *The Conditions of Learning*. Holt, Rinehart and Winston, 1965.

Hill, Winfred F. *Learning, A Survey of Psychological Interpretations*. San Francisco: Chandler, 1963.

Kingsley, H. L. and R. Garry. *The Nature and Conditions of Learning*, 2nd ed. Englewood Cliffs, N.J.: Prentice-Hall, 1957.

S.C.E.R.T., West Bengal
Library
Calcutta
25/3, B. C.

BANIPUR

The Psychological Foundations of Education Series. *Edited by* Victor H.

Michigan State Universit

370.15
CRA

This series is designed to provide a deeper examination of specific areas which are not given thorough treatment in the many comprehensive textbooks now in use. Teachers and students on both undergraduate and graduate levels will benefit from the advanced coverage of pertinent subject matter included in these up-to-date, expertly written paperback volumes. Theoretical material is an important part of each book, but emphasis is centered on practical applications. Used in conjunction with a comprehensive text, these books will increase the impact and effectiveness of current courses in the psychological foundations sequence.

The Series Editor: Victor H. Noll, (Ph.D., University of Minnesota), is Professor of Education at Michigan State University. Dr. Noll is co-editor of *Readings in Educational Psychology* and author of *Introduction to Educational Measurement.*

Titles Now Available . . .

PSYCHOLOGY OF ADOLESCENCE FOR TEACHERS

By Glenn Myers Blair, *and* R. Stewart Jones, *both of University of Illinois*

PSYCHOLOGY OF THE CHILD IN THE CLASSROOM

By Don C. Charles, *Iowa State University*

THE PSYCHOLOGY OF LEARNING IN THE CLASSROOM

By Robert C. Craig, *Marquette University*

THE MENTALLY RETARDED CHILD IN THE CLASSROOM

By Marion J. Erickson, *Ypsilanti Public Schools*

PROBLEM SOLVING IN THE CLASSROOM

By Bryce B. Hudgins, *Graduate Institute of Education, Washington University*

TEACHER SELF-EVALUATION

By Ray H. Simpson, *University of Illinois*

GUIDANCE IN THE CLASSROOM

By Ruth Strang, *University of Arizona, and* Glyn Morris, Assistant Supervisor of Guidance and Curriculum, Lewis County, New York

GIFTED CHILDREN IN THE CLASSROOM

By E. Paul Torrence, *University of Minnesota*

THE MACMILLAN COMPANY, 60 FIFTH AVE., NEW YORK, N. Y. 10011
32545